



MASK 2017

ARIA digitally-enabled, integrated, person-centred care for rhinitis and asthma multimorbidity using real-world-evidence

Ulrik, Charlotte Suppli; MASK study group

Published in:
Clinical and Translational Allergy

DOI:
[10.1186/s13601-018-0227-6](https://doi.org/10.1186/s13601-018-0227-6)

Publication date:
2018

Document version
Publisher's PDF, also known as Version of record

Document license:
[CC BY](#)

Citation for published version (APA):
Ulrik, C. S., & MASK study group (2018). MASK 2017: ARIA digitally-enabled, integrated, person-centred care for rhinitis and asthma multimorbidity using real-world-evidence. *Clinical and Translational Allergy*, 8(1), [45]. <https://doi.org/10.1186/s13601-018-0227-6>

REVIEW

Open Access



MASK 2017: ARIA digitally-enabled, integrated, person-centred care for rhinitis and asthma multimorbidity using real-world-evidence

J. Bousquet^{1,2,3*}, S. Arnavielhe⁴, A. Bedbrook¹, M. Bewick⁵, D. Laune⁴, E. Mathieu-Dupas⁴, R. Murray⁶, G. L. Onorato¹, J. L. Pépin^{7,8}, R. Picard⁹, F. Portejoie¹, E. Costa¹⁰, J. Fonseca^{11,12}, O. Lourenço¹³, M. Morais-Almeida¹⁴, A. Todo-Bom¹⁵, A. A. Cruz^{16,17}, J. da Silva¹⁸, F. S. Serpa¹⁹, M. Illario²⁰, E. Menditto²¹, L. Cecchi²², R. Monti²³, L. Napoli²⁴, M. T. Ventura²⁵, G. De Feo²⁶, D. Larenas-Linnemann²⁷, M. Fuentes Perez²⁸, Y. R. Huerta Villabolas²⁸, D. Rivero-Yeverino²⁹, E. Rodriguez-Zagal³⁰, F. Amat^{31,32}, I. Annesi-Maesano³³, I. Bosse³⁴, P. Demoly³⁵, P. Devillier³⁶, J. F. Fontaine³⁷, J. Just^{31,32}, T. P. Kuna³⁸, B. Samolinski³⁹, A. Valiulis^{40,41}, R. Emuzyte⁴², V. Kvedariene⁴³, D. Ryan^{44,45}, A. Sheikh⁴⁶, P. Schmidt-Grendelmeier⁴⁷, L. Klimek^{48,49}, O. Pfaar^{48,49}, K. C. Bergmann^{50,51}, R. Mösges^{52,53}, T. Zuberbier^{50,51}, R. E. Roller-Wirnsberger⁵⁴, P. Tomazic⁵⁵, W. J. Fokkens⁵⁶, N. H. Chavannes⁵⁷, S. Reitsma⁵⁶, J. M. Anto^{58,59,60,61}, V. Cardona⁶², T. Dedeu^{63,64}, J. Mullol^{65,66}, T. Haahtela⁶⁷, J. Salimäki⁶⁸, S. Toppila-Salmi⁶⁷, E. Valovirta^{69,70}, B. Gemcioğlu⁷¹, A. Yorgancioglu^{72,73}, N. Papadopoulos^{74,75}, E. P. Prokopoulos⁷⁶, S. Bosnic-Anticevich⁷⁷, R. O'Hehir^{78,79}, J. C. Ivancevich⁸⁰, H. Neffen⁸¹, E. Zernotti⁸², I. Kull⁸³, E. Melen^{84,85}, M. Wickman⁸⁶, C. Bachert⁸⁷, P. Hellings^{3,88,89}, S. Palkonen⁹⁰, C. Bindeslev-Jensen⁹¹, E. Eller⁹¹, S. Wasserman⁹², M. Sova⁹³, G. De Vries⁹⁴, M. van Eerd⁹⁴, I. Agache⁹⁵, T. Casale⁹⁶, M. Dykewicz⁹⁷, R. N. Naclerio⁹⁸, Y. Okamoto⁹⁹, D. V. Wallace¹⁰⁰ and MASK study group

Abstract

mHealth, such as apps running on consumer smart devices is becoming increasingly popular and has the potential to profoundly affect healthcare and health outcomes. However, it may be disruptive and results achieved are not always reaching the goals. Allergic Rhinitis and its Impact on Asthma (ARIA) has evolved from a guideline using the best evidence-based approach to care pathways suited to real-life using mobile technology in allergic rhinitis (AR) and asthma multimorbidity. Patients largely use over-the-counter medications dispensed in pharmacies. Shared decision making centered around the patient and based on self-management should be the norm. Mobile Airways Sentinel network (MASK), the Phase 3 ARIA initiative, is based on the freely available MASK app (*the Allergy Diary*, Android and iOS platforms). MASK is available in 16 languages and deployed in 23 countries. The present paper provides an overview of the methods used in MASK and the key results obtained to date. These include a novel phenotypic characterization of the patients, confirmation of the impact of allergic rhinitis on work productivity and treatment patterns in real life. Most patients appear to self-medicate, are often non-adherent and do not follow guidelines. Moreover, *the Allergy Diary* is able to distinguish between AR medications. The potential usefulness of MASK will be further explored by POLLAR (Impact of Air Pollution on Asthma and Rhinitis), a new Horizon 2020 project using the *Allergy Diary*.

Keywords: App, ARIA, Asthma, Care pathways, MASK, mHealth, Rhinitis

*Correspondence: jean.bousquet@orange.fr

¹ MACVIA-France, Fondation Partenariale FMC VIA-LR, CHRU Arnaud de Villeneuve, 371 Avenue du Doyen Gaston Giraud, Montpellier, France
Full list of author information is available at the end of the article



Background

Allergic rhinitis (AR) is the most common chronic disease worldwide. Evidence-based guidelines have improved knowledge on rhinitis and made a significant impact on AR management. However, many patients remain inadequately controlled and the costs for society are enormous, in particular due to the major impact of AR on school and work productivity [1, 2]. Unmet needs have identified clearly many gaps. These include (1) sub-optimal rhinitis and asthma control due to medical, cultural and social barriers [3, 4], (2) poor understanding of endotypes [5], better characterization of phenotypes and multimorbidities [6], better understanding of gender differences [7], (3) assessment of sentinel networks in care pathways for allergen and pollutants exposures, using symptom variation [8], (4) lack of stratification of patients for optimized care pathways [9] and (5) lack of multidisciplinary teams within integrated care pathways, endorsing innovation in real life clinical trials [8] and encouraging patient empowerment [10, 11].

Mobile health (mHealth) is the use of information and communication technology (ICT) for health services and information transfer [12]. mHealth, including apps running on consumer smart devices (i.e., smartphones and tablets), is becoming increasingly popular and has the potential to profoundly impact on healthcare [13]. Novel app-based collaborative systems can have an important role in gathering information quickly and improving coverage and accessibility of prevention and treatment [14]. Implementing mHealth innovations may also have disruptive consequences [15], so it is important to test applicability in each individual situation [16]. A rapid growth of the health apps market has been seen with an estimated 325,000 health apps available in 2017 for most fields of medicine [17]. Benefits and drawbacks have been estimated for a number of disease [18]. The application of mHealth solutions can support the provision of high quality care to patients with AR or asthma, to the satisfaction of both patients and health care professionals, with a reduction in both health care utilization and costs [19]. Appropriately identifying and representing stakeholders' interests and viewpoints in evaluations of mHealth is a critical part of ensuring continued progress and innovation [20]. Patient, caregiver and clinician evaluations and recommendations play an important role in the development of asthma mHealth tools to support the provision of asthma management [21]. Smart devices and internet-based applications are already used in rhinitis and asthma and may help to address some unmet needs [22]. However, these new tools need to be tested and evaluated for acceptability, usability and cost-effectiveness.

Allergic Rhinitis and its Impact on Asthma (ARIA) has evolved from an evidence-based guideline using the best

evidence based approach [1, 23–25] to care pathways using mobile technology in AR and asthma multimorbidity [26]. ARIA appears to be close to the patient's needs but real-life data suggest that few patients follow guideline recommendations and that they often self-medicate. Moreover, patients frequently using OTC medications dispensed in pharmacies [27]. Shared decision making (SDM) centered around the patient for self-management should be used more often.

Mobile Airways Sentinel network (MASK), the Phase 3 ARIA initiative, has been initiated to reduce the global burden of rhinitis and asthma multimorbidity, giving the patient and the health care professional simple tools to better prevent and manage respiratory allergic diseases. More specifically, MASK is focusing on (1) understanding the disease mechanisms and the effects of air pollution in allergic diseases and asthma, (2) better appraising the burden incurred by medical needs and indirect costs, (3) the implementation of multi-sectoral care pathways integrating self-care, air pollution and patient's literacy, using emerging technologies with real world data using the AIRWAYS ICPs algorithm [28], (4) proposing individualized and predictive medicine in rhinitis and asthma multimorbidity, (5) proposing the basis for a sentinel network at the global level for pollution and allergy and (6) assessing the societal implications of exposure to air pollution and allergens and its consequences on health inequalities globally.

The freely available MASK app (*the Allergy Diary*, Android and iOS) [26] is combined with an inter-operable tablet for physicians and other health care professionals (HCPs [29]), using the same extremely simple colloquial language to manage AR (Visual Analogue Scale: VAS) [30, 31]. It is being combined with data on allergen and pollution exposure (POLLAR).

MASK will be scaled up using the EU EIP on AHA strategy [32]. Phase 4 is starting in 2018 and will focus on "change management". MASK is supported by several EU grants and is a WHO GARD (Global Alliance against Chronic Respiratory Diseases) research demonstration project (Table 1).

Methods

Users

The *Allergy Diary* is used by people who searched the internet, Apple App store, Google Play or in any other way. The pages of the App are on the Euforea-ARIA website (www.euforea.eu/about-us/aria.html). A few users were clinic patients to whom the app was recommended by their physicians. Users were not requested to complete the diary for a minimum number of days. However, due to anonymization of data, no specific information on the route of access to the app could be gathered [33, 34].

Table 1 European Union and World Health Organization links of ARIA and MASK

	Date		WHO	EU
ARIA	1999	Workshop	WHO HQ	
	2003–2013	CC rhinitis and asthma	Montpellier	
	2012–	GARD demonstration project	WHO HQ	
	2004–2010	GA2LEN		FP6
	2011–2015	MeDALL		FP7
MASK	2014–	MACVIA-LR		DG Santé-CNECT
	2014–	GARD demonstration project	WHO HQ	
	2014–	EIP on AHA B3		DG Santé-CNECT
	2015–2016	SPAL		Structural and development funds
	2015–2017	Sunfrail		
	2017–	Twinning		DG Santé-CNECT
	2018–	POLLAR		EIT Health

The first question of the App is “I have allergic rhinitis”: Yes/No. We tested the sensitivity and specificity of this question [33]. 93.4% users with a positive answer had nasal symptoms versus 12.1% of users with a negative answer. In the first two versions of the App, allergy was not considered in the user’s questionnaire and AR cannot be differentiated from chronic rhinosinusitis. It is now included in the third version of the App (June 2018) and we will be able to answer more appropriately to this question in the next study. The results of the pilot study were confirmed in over 9000 users.

Settings

MASK is available in 23 countries and 16 languages. To date (01-09-2018) the app has been used by over 24,000 people.

Ethics and privacy of data

The Allergy Diary is CE1 registered. The terms of use were translated into all languages and customized by lawyers according to the legislation of each country, allowing the use of the results for research and commercial purposes. The example of the UK terms of use have been provided in a previous paper [33].

Geolocation

EU data protection rules have changed since the implementation of the General Data Protection Regulation (Art. 4 para. 1 no. 1 GDPR) [35]. Data anonymization is a method of sanitization for privacy. Anonymization renders personal data “in such a manner that the data subject is not or no longer identifiable” [36]. The European Commission’s Article 29 Working Party (WP29) stated already in 2014 with regards to the Directive 95/46/EC [37] that geolocation information is not only personal

data but also to be considered as an identifier itself [38, 39]. Processing personal data by means of an app, like e.g. App Diary, besides Directive 95/46/EC [37] also Directive 2002/58/EC [40] as amended by Directive 2009/136/EC [41] applies.

Geolocation was studied for all people who used the Allergy Diary App from December 2015 to November 2017 and who reported medical outcomes. In contradistinction to noise addition (randomization), k-anonymity [42, 43] is an acceptable method for the anonymization of MASK data (generalization) [44] and results can be used for other databases.

Privacy assessment impact

Privacy impact assessments (PIAs), also known as data protection impact assessments (DPIAs) in EU law, is required by GDPR (Article 35 Working Party (WP35)). PIA is a systematic process to assess privacy risks to individuals in the collection, use, and disclosure of their personal data. The GDPR introduced PIAs to identify high risks to the privacy rights of individuals when processing their personal data. The assessment shall contain at least:

1. a systematic description of the envisaged processing operations and the purposes of the processing, including, where applicable, the legitimate interest pursued by the controller;
2. an assessment of the necessity and proportionality of the processing operations in relation to the purposes;
3. an assessment of the risks to the rights and freedoms of data subjects and
4. the measures envisaged to address the risks, including safeguards, security measures and mechanisms to ensure the protection of personal data and to dem-

onstrate compliance with this Regulation taking into account the rights and legitimate interests of data subjects and other persons concerned.

When these risks are identified, the GDPR expects that an organization formulates measures to address these risks. Those measures may take the form of technical controls such as encryption or anonymization of data.

The PIA analysis is a self-declarative analysis. In France, the local GDPR representative (*Commission Informatique et Liberté*, CNIL) has provided a software to guide the reflexion around security of personal data and the exposure risks in case of security fails. This software has been used to assess all the risks to be considered through the app uses. The conclusion was that is “negligeable”.

The field is moving very fast. In France, June, 10 2018, the modified law “LIL” (*Loi Informatique et Liberté*, 2018-493, <https://www.cnil.fr/fr/loi-78-17-du-6-janvier-1978-modifiee>) was enacted with a special focus on health-related personal data. Even if the articulation of GDPR and LIL is still unclear, we can anticipate that the app use will remain risk free.

Allergy Diary

The app collects information on AR and asthma symptoms experienced (nasal and ocular) and on disease type (intermittent/persistent) [33] (Table 3). Anonymized and geolocalized users assess daily how symptoms impact their control and AR treatment using the touchscreen functionality on their smart phone to click on five consecutive VAS (i.e. general, nasal and ocular symptoms, asthma and work) (Table 2; Fig. 1). Users input their daily medications using a scroll list that contains all country-specific OTC and prescribed medications available (Fig. 2). The list populated using IMS data and revised by country experts is continuously revised by country experts.

There is a high degree of correlation between these VAS measurements. The example of VAS global measured and VAS nose is presented in Fig. 2.

Outcomes

Five VAS measurements [VAS-global measured, VAS-nose, VAS-eye, VAS-asthma and VAS-work (Table 4)] and a calculated VAS-global score (VAS-nasal + VAS-ocular divided by 2) were assessed [34]. VAS levels range from zero (not at all bothersome) to 100 (very bothersome). Independency of VAS questions was previously confirmed using the Bland and Altman regression analysis [34, 45].

Table 2 Questions on symptoms and impact of symptoms (from Bousquet et al. [33])

Q1: I have rhinitis: Yes/No Q2: I have asthma: Yes/No Q3: My symptoms (tick) <input type="checkbox"/> Runny nose <input type="checkbox"/> Itchy nose <input type="checkbox"/> Sneezing <input type="checkbox"/> Congestion (blocked nose) <input type="checkbox"/> Itchy eyes <input type="checkbox"/> Red eyes <input type="checkbox"/> Watery eyes	Q4: How they affect me: My symptoms (tick) <input type="checkbox"/> Affect my sleep <input type="checkbox"/> Restrict my daily activities <input type="checkbox"/> Restrict my participation in school or work <input type="checkbox"/> Are troublesome
--	--

Transfer of personal data from the App to a print

Patients cannot give access to their electronic data to a HCP due to privacy policies. However, they can easily print the daily control of their disease and the medications that they filled in the *Allergy Diary* as follows (Fig. 3).

Additional questionnaires

MASK also includes EQ-5D (EuroQuol) [46–48], Work Productivity and Activity Impairment Allergic Specific (WPAI-AS) [49] and Control of AR and Asthma Test (CARAT) [50–53]. The Epworth Sleepiness Questionnaire [54, 55] is included (June 2018).

Medications

A scroll list is available for all OTC and prescribed medications of the 23 countries. The International Non-proprietary Names classification was used for drug nomenclature [56]. 85 INNs and 505 medications were identified (Fig. 1).

Adherence to treatment

Globally, non-adherence to medications is a major obstacle to the effective delivery of health care. Many mobile phone apps are available to support people to take their medications and to improve medication adherence [57, 58]. However, a recent meta-analysis found that the majority did not have many of the desirable features and were of low quality [57]. However, it is unknown how people use apps, what is considered adherent or non-adherent in terms of app usage, or whether adherence with an app in anyway reflects adherence with medication or control.

In MASK, we did not use adherence questionnaires but first attempted to assess short-term adherence and then to address the long-term issues. [59].

Digitalized ARIA symptom-medication score

Symptom-medication scores are needed to assess the control of allergic diseases. They are currently being

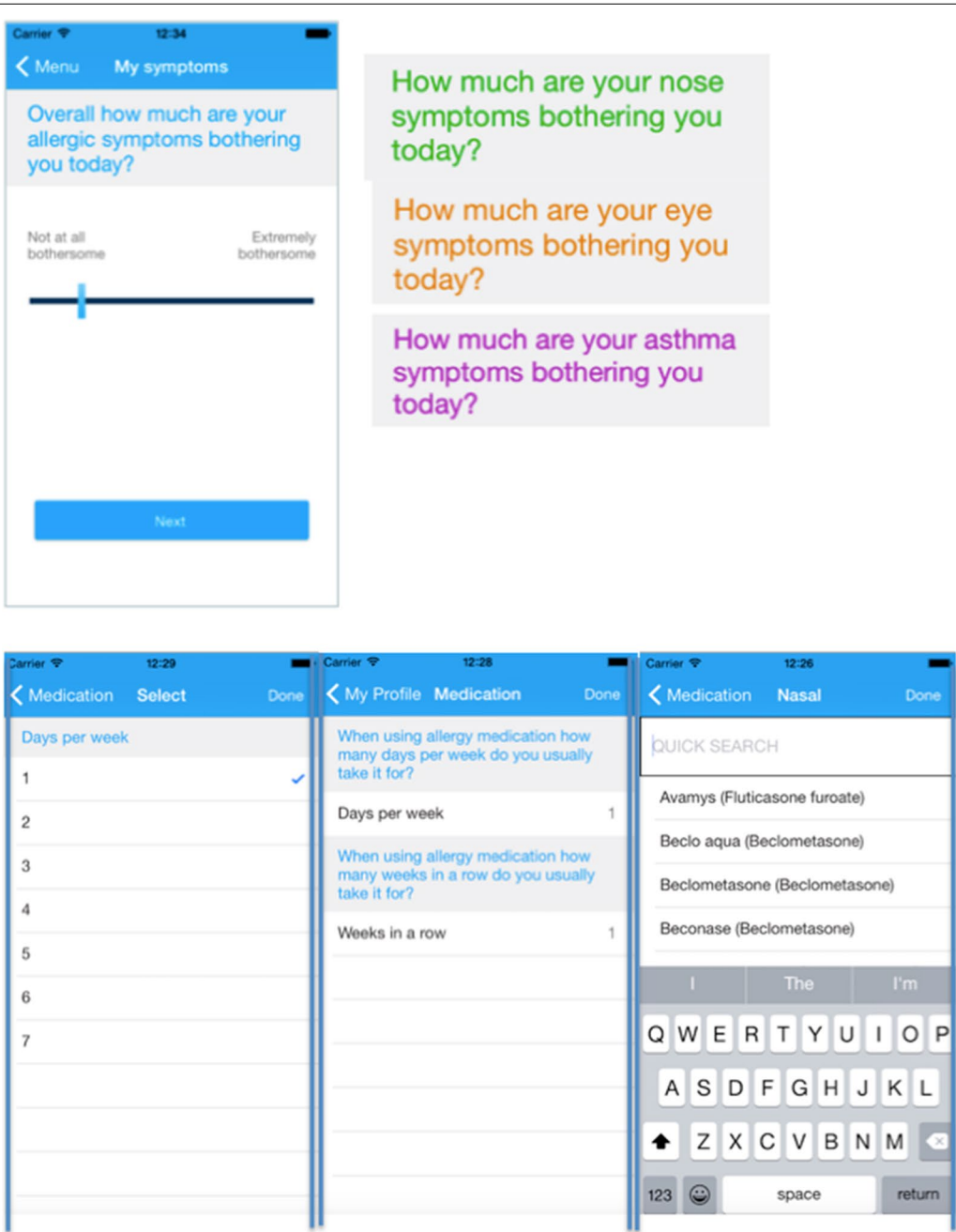


Fig. 1 Allergy Diary screens relating to Visual Analogue Scale and medications (from Bousquet et al. [26])

developed for MASK and are being compared with existing ones [60].

MASK algorithm and clinical decision support system

Clinical decision support systems (CDSS) are software algorithms that advise health care providers on the diagnosis and management of patients based on the interaction of patient data and medical information, such as prescribed drugs. CDSS should be based on the

best evidence and algorithms to aid patients and health care professionals to jointly determine the treatment and its step-up or step-down strategy for an optimal disease control.

The selection of pharmacotherapy for AR patients depends on several factors, including age, prominent symptoms, symptom severity, AR control, patient preferences and cost. Allergen exposure, pollution and resulting symptoms vary, needing treatment

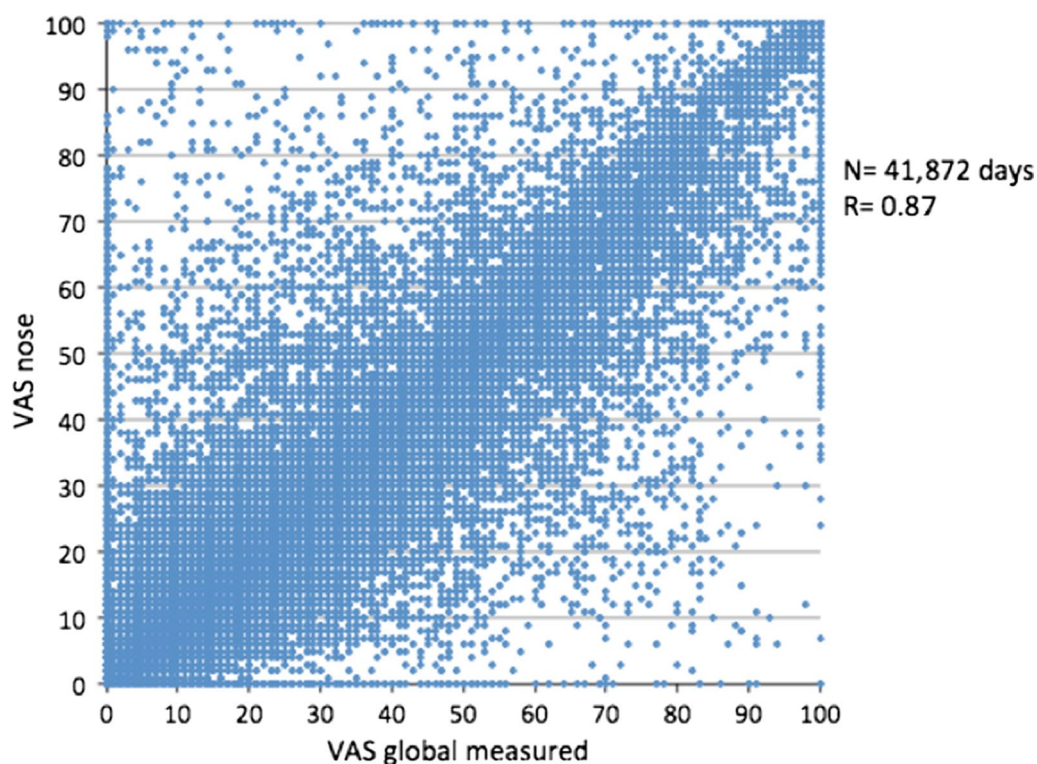


Fig. 2 Correlation between Visual Analog Scale (VAS) global measured and nasal symptoms (VAS nose) (unpublished)

adjustment. In AR, The MASK CDSS is incorporated into an interoperable tablet [29] for HCPs (*ARIA Allergy Diary Companion*) [10, 26]. This is based on an algorithm to aid clinicians to select pharmacotherapy for AR patients and to stratify their disease severity [26] (Fig. 4). It uses a simple step-up/step-down individualized approach to AR pharmacotherapy and may hold the potential for optimal control of symptoms, while minimizing side-effects and costs. However, its use varies depending on the availability of medications in the different countries and on resources. The algorithm is now digitalized and available in English (Fig. 5).

MASK follows the CHRODIS criteria of “Good Practice”

The European Commission is co-funding a large collaborative project named JA-CHRODIS in the context of the 2nd EU Health Programme 2008–2013 [61]. JA-CHRODIS has developed a check-list of 27 items for the evaluation of Good Practices (GP) (<http://chrodis.eu/our-work/04-knowledge-platform/>). According to the JA-CHRODIS, a Good Practice has been proven to work well and produce good results, and is therefore recommended as a model to be scaled up. The JA-CHRODIS criteria are grouped into nine categories:

- Equity.
- Practice.
- Ethical considerations.
- Evaluation.
- Empowerment and participation.
- Target population.
- Sustainability.
- Governance.
- Scalability

As part of SUNFRIL, MASK tested the 27 item criteria of CHRODIS and was found to be an example of Good Practice [62].

Pilot study of mobile phone technology in AR

A pilot study in 3260 users found that *Allergy Diary* users were able to properly provide baseline simple phenotypic characteristics. Troublesome symptoms were found mainly in the users with the largest number of symptoms. Around 50% of users with troublesome rhinitis and/or ocular symptoms suffered work impairment. Sleep was impaired by troublesome symptoms and nasal obstruction (Fig. 6). results suggest novel concepts and research questions in AR that may not be identified using classical methods [33].

- 1- Open the Allergy Diary app and choose "Show Data on Computer" in the main menu
- 2- Go to www.macvia-aria-allergy-diary.com/data on your PC/Laptop (enter this URL in the address bar of the browser from your PC/Laptop)
- 3- Scan the QR code with the Allergy Diary app
- 4- The screen with your personal data can be seen
- 5- And you can also print these data (see figure below)



Fig. 3 Transfer of patient information on a computer and printed information (from Bousquet et al. [46])

Validation of the MASK Visual Analogue Scale on cell phones

VAS included in the *Allergy Diary* was found to be a validated tool to assess control in AR patients following COSMIN guidelines [63] in 1225 users and 14,612 days: internal consistency (Cronbach's α -coefficient > 0.84 and test-retest > 0.7), reliability (intra-class correlation coefficients), sensitivity and acceptability [64]. In addition, e-VAS had a good reproducibility when users ($n = 521$) answered the e-VAS twice in less than 3 h.

Transfer of innovation of AR and asthma multimorbidity in the elderly: Reference Site Twinning (EIP on AHA)

The EIP on AHA includes 74 Reference Sites. The aim of this TWINNING was to transfer innovation from the MASK App to other reference sites. The phenotypic characteristics of rhinitis and asthma multimorbidity in adults and the elderly are compared using validated

mHealth tools (i.e. the Allergy Diary and CARAT) in 23 Reference Sites or regions across Europe and Argentina, Australia, Brazil and Mexico [46]. This will improve understanding, assessment of burden, diagnosis and management of rhinitis in the elderly by comparison with an adult population. The pilot study has been completed in Germany and the project is fully operative using two protocols (Table 3).

Results

Work productivity

AR impairs social life, work and school productivity. Indirect costs associated with lost work productivity are the principal contributor to the total AR costs and result mainly from impaired work performance by presenteeism [2]. The severity of AR symptoms was the most consistent disease-related factor associated with impact of AR on work productivity, although ocular symptoms and sleep disturbances may independently affect work



productivity of uncontrolled AR assessed by VAS [34]. In users with uncontrolled rhinitis (VAS global measured ≥ 50), approximately 90% had some work impairment and over 50% had severe work impairment

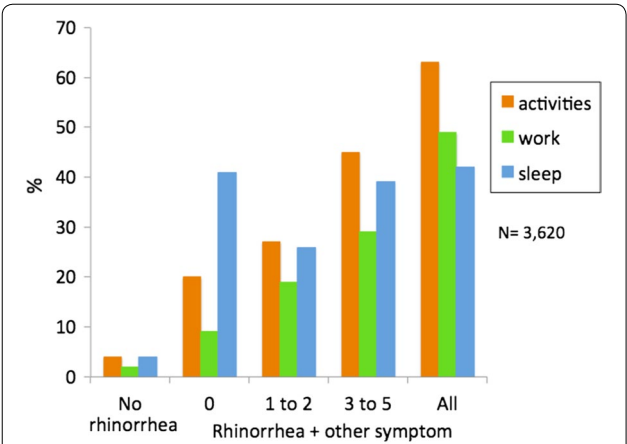


Fig. 6 Impact of allergic rhinitis depending on the number of symptoms (from Bousquet et al. [33])

(VAS-work \geq 50). There was a significant correlation between VAS-global calculated and VAS-work (Rho=0.83, $p<0.00001$, Spearman rank test). The study has been extended to almost 17,000 days and similar results were observed (Fig. 7).

The baseline study found that bothersome symptoms, nasal obstruction and ocular symptoms were involved in work productivity impact [33] (Fig. 8).

The *Allergy Diary* includes the WPAI:AS in six EU countries. All consecutive users who completed the VAS-work from June 1 to July 31, 2016 were included in the study [66]. A highly significant correlation was found between Questions 4 (impairment of work) and 9 (impairment of activities) in 698 users (Rho=0.85).

All these studies combine to confirm the impact of uncontrolled AR on work productivity.

Novel phenotypes of allergic diseases

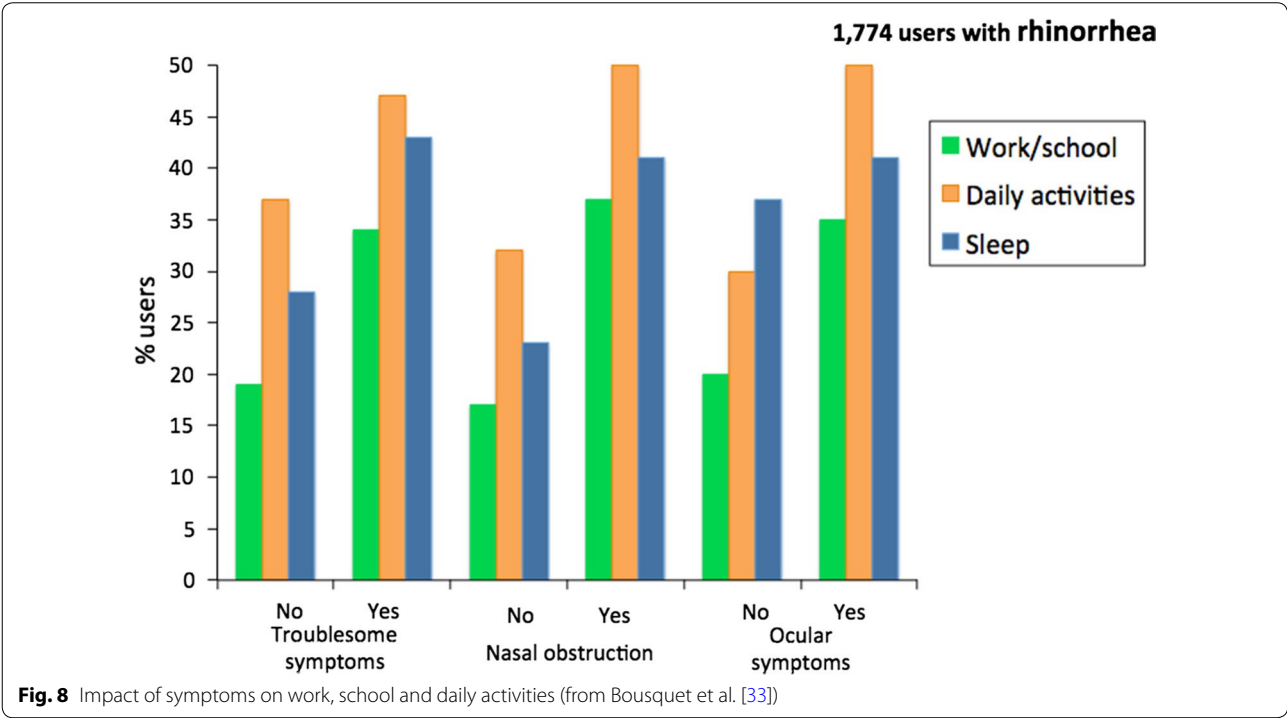
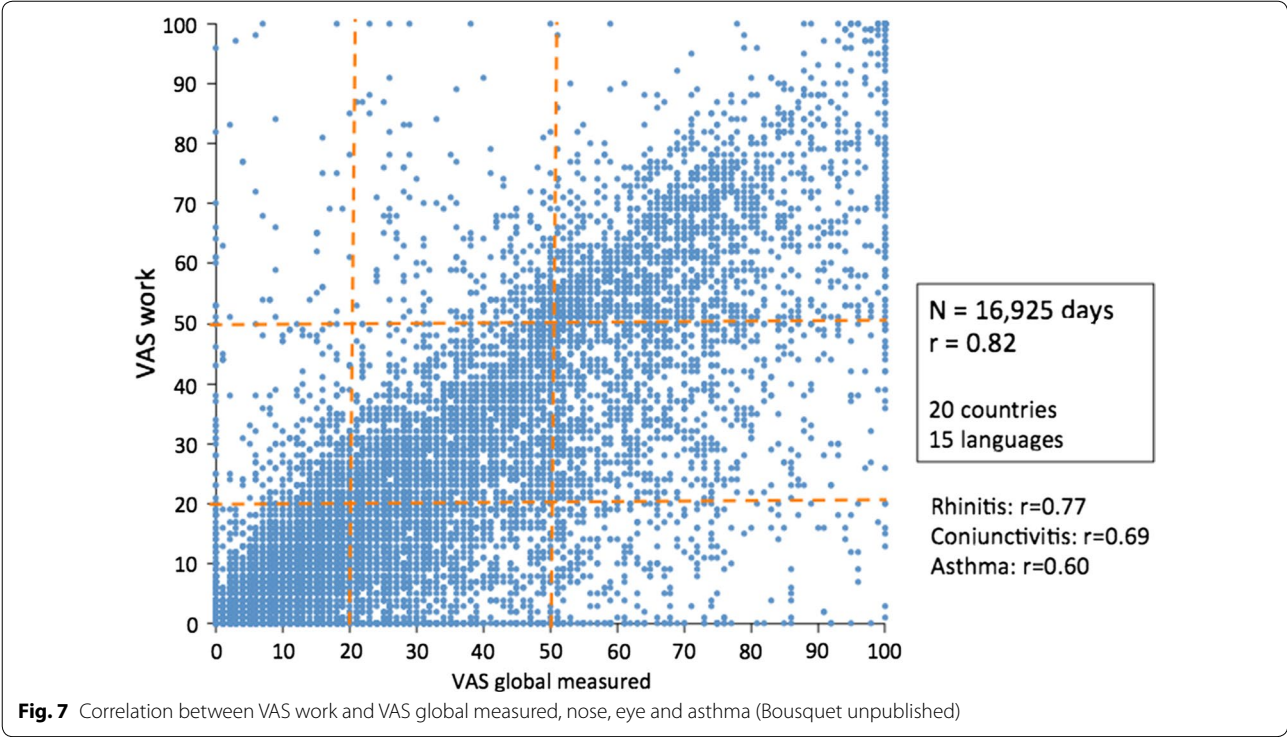
Multimorbidity in allergic airway diseases is well known [6], but no data exist regarding the daily dynamics of symptoms. The *Allergy Diary* assessed the presence and control of daily allergic multimorbidity (asthma, conjunctivitis, rhinitis) and its impact on work productivity in 4025 users and 32,585 days monitored in 19 countries from May 25, 2015 to May 26, 2016. VAS levels <20/100 were categorized as “Low” burden and VAS levels \geq 50/100 as “High” burden. VAS global measured levels assessing the global control of the allergic disease were significantly associated with daily allergic multimorbidity. Eight hypothesis-driven patterns were defined based on “Low” and “High” VAS levels. There were <0.2% days of Rhinitis Low and Asthma High or Conjunctivitis High patterns. There were 5.9% days with a Rhinitis High—Asthma Low pattern. There were 1.7% days with a Rhinitis High—Asthma High—Conjunctivitis Low pattern. A novel Rhinitis High—Asthma High—Conjunctivitis High pattern was identified in 2.9% days and had the greatest impact on uncontrolled VAS global measured and impaired work productivity (Fig. 9). The mobile technology enabled investigation in a novel approach of the intra-individual variability of allergic multimorbidity using days. It identified an unrecognized extreme pattern of uncontrolled multimorbidity [59].

Treatment of allergic rhinitis using mobile technology with real world data

Large observational implementation studies are needed to triangulate the findings from randomized control trials (RCTs) as they reflect “real world” everyday practice. We attempted to provide additional and complementary insights into the real-life AR treatment using mobile technology. The *Allergy Diary* was filled in by 2871 users

Table 3 Twinning protocols (from Bousquet et al., [65])

	Protocol 1	Protocol 2
	Short version	Long version
Allergy Diary	+	+
Equation 5D	Optional	+
Physician’s questionnaire		+
Ethics committee	Not needed	Needed (obtained in some Reference Sites)
Inform consent	Terms of Reference on App	From with patient’s signature
Recruitment	Any user Persons attending clinic visits can be included	Persons attending clinic visits included with a physician’s diagnosis of allergic disease and allergen sensitization (IgE and/or skin tests)
Physician’s questionnaire		+



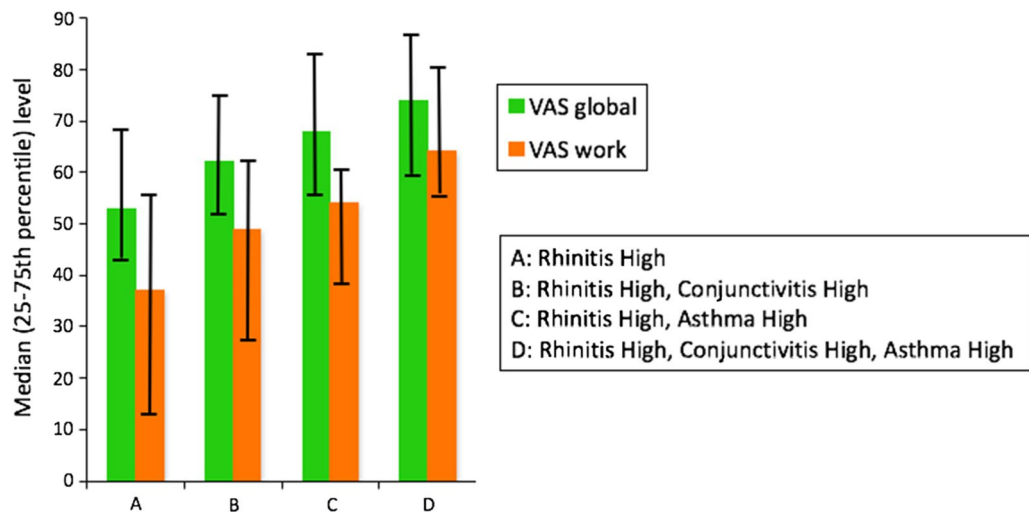


Fig. 9 VAS levels in severe rhinitis depending on multimorbidity (from Bousquet et al. [60])

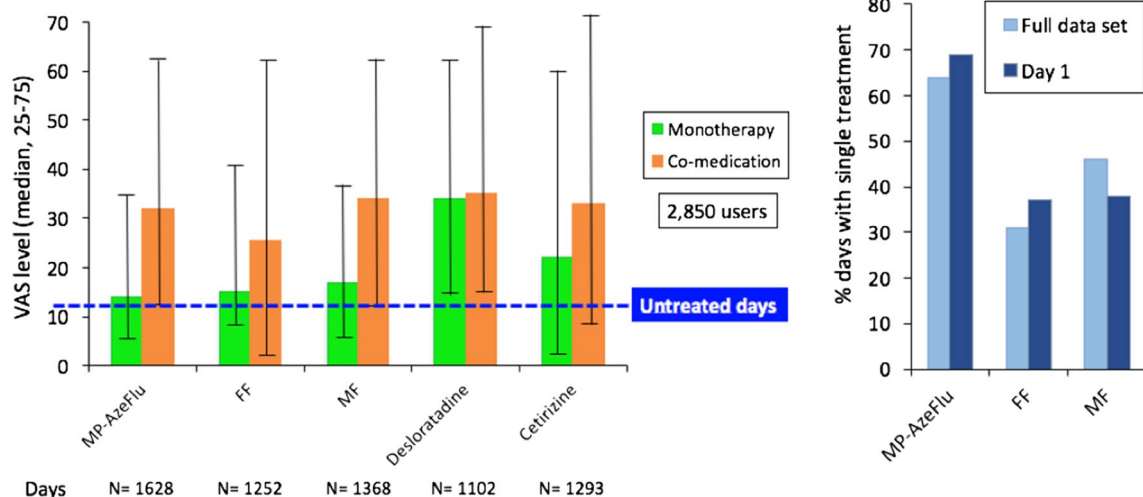


Fig. 10 Treatments received in MAS (from Bousquet et al. [59])

who reported 17,091 days of VAS in 2015 and 2016. Medications were reported for 9634 days. The assessment of days appeared to be more informative than the course of the treatment as, in real life, patients rarely use treatment on a daily basis; rather, they appear to increase treatment use with the loss of symptom control and to stop it when symptoms disappear. The *Allergy Diary* allowed the differentiation between treatments within or

between classes (intranasal corticosteroid use containing medications and oral H1-antihistamines). The control of days differed between no (best control), single or multiple treatments (worst control) (Fig. 10). The study confirms the usefulness of the *Allergy Diary* in accessing and assessing everyday use and practice in AR [59].

Adherence to medications was studied in almost 7000 users reporting medications. 1770 users reported over

7 days of VAS between January 1, 2016 and August 31, 2016 and a major lack of adherence to treatment was observed for all medications (Menditto et al., in preparation).

MASK in the pharmacy

Multidisciplinary integrated care is necessary to reduce the burden of chronic diseases. A significant proportion of patients with AR self-manage their condition and often the pharmacist is the first HCP that a person with nasal symptoms contacts [66, 67]. Pharmacists are trusted in the community and are easily accessible. As such, pharmacists are an important part of the multidisciplinary healthcare team, acting at different steps of rhinitis care pathways.

Pharmacists are important in many areas of intervention in AR:

- Recognizing (identification).
- Risk assessment/stratification.
- OTC treatment.
- Manage refills.
- Patient education.
- Referral to a physician.
- Administration of topical treatment technique and adherence to treatment.

Simple algorithms and tools are essential in the routine implementation of these steps. A first approach was made by ARIA in the pharmacy [68] and is currently being updated using MASK.

POLLAR (Impact of air POLLution on Asthma and Rhinitis)

AR and asthma are impacted by allergens and air pollution. However, interactions between air pollution, sleep [55, 69] and allergic diseases are insufficiently understood. POLLAR aims at combining emerging technologies [search engine TLR2 (technology readiness level); pollution sampler TLR6, App TLR9] with machine learning to (1) understand effects of air pollution in AR and its impact on sleep, work, asthma, (2) propose novel care pathways integrating pollution and patient's literacy, (3) study sleep, (4) improve work productivity, (5) propose the basis for a sentinel network at the EU level for

pollution and allergy and (6) assess the societal implications of the interaction.

POLLAR will use the freely existing application for AR monitoring (*Allergy Diary*, 14,000 users, TLR8) combined with a new tool allowing queries on allergen and pollen (TLR2) and existing pollution data. Machine learning will be used to assess the relationship between air pollution and AR comparing polluted and non-polluted areas in 6 EU countries. Data generated in 2018 will be confirmed in 2019 and extended by the individual assessment of pollution (Canarin[®], portable sensor, TLR6) in AR and sleep apnea patients used as a control group having impaired sleep. The geographic information system GIS will map the results.

Google Trends (GT) searches trends of specific queries in Google and reflects the real-life epidemiology of AR. We compared GT terms related to allergy and rhinitis in all European Union countries, Norway and Switzerland from January 1, 2011 to December, 20 2016. An annual and clear seasonality of queries was found in most countries but the terms 'hay fever', 'allergy' and 'pollen'—show cultural differences [70]. Using longitudinal data in different countries and multiple terms, we identified an awareness-related spike of searches (December 2016) [70]. In asthma, GTs can identify spikes of mortality as was found in Australia and Kuwait in 2016. However, the usual peaks of asthma during allergen exposure or virus infections cannot be easily monitored [71].

Global applicability of MASK and POLLAR, and their benefits

Although MASK has been devised to optimize care pathways in rhinitis and asthma multimorbidity, its applicability is far more extensive (Table 4).

For MASK, several steps have been achieved.

Conclusion

MASK is a novel approach to obtain real-life data concerning rhinitis and asthma multimorbidity and to help patients and physicians for a better SDM. It can be used for multiple purposes in a friendly manner in order to improve the control of allergic diseases in a cost-effective approach.

Table 4 Global applicability of MASK

Applicability	MASK
Clinical practice	<p>Physicians will be able to read the files of the patients in order to</p> <p>Optimize treatment for the patient and, in particular, the current or the next pollen season</p> <p>Assess and increase the adherence to treatment</p> <p>Help for shared decision making</p> <p>Prescribe allergen immunotherapy (AIT) more rapidly when the patient is not controlled despite optimal pharmacologic treatment</p> <p>Determine the efficacy of AIT in patients</p> <p>The Allergy Diary is an essential tool to provide personalized medicine in AR and asthma</p>
Change management	<p>The first results of MASK indicate that many patients are uncontrolled and non-adherent to treatment</p> <p>Moreover, they appear to use their medications as needed and not as a regular basis as prescribed</p> <p>Change management is needed</p>
Patient empowerment	<p>Better understanding of the symptoms</p> <p>Sentinel network linking aerobiology data and control</p> <p>Improved adherence</p> <p>Self-management</p> <p>Patient empowerment</p> <p>Messages sent by the App</p>
Clinical trials	<p>For RCTs, it is essential to have clarity on definitions, and relevant tools. The Allergy Diary allows</p> <p>To better stratify the patients needing AIT</p> <p>To assess the efficacy of AIT during the trial</p> <p>To assess the efficacy when AIT is stopped</p> <p>Observational studies are of key importance to confirm RCTs and bring new hypotheses for the treatment of AR and asthma</p>
Registration and reimbursement of medicines	<p>Controlled trials designed with a uniform approach will be more easily evaluated by the Health Technology Assessment agencies (such as NICE) for reimbursement. The Allergy Diary uses EQ-5D, a validated measure of utility</p> <p>Better understanding of direct and indirect costs</p> <p>Controlled trials designed with a uniform approach will help to synchronize data from real-life world regarding clinical effects and safety/tolerability of new drugs (post-marketing pharmacovigilance)</p>
Research on mechanisms and genetics	<p>A uniform definition and a collaborative approach to epidemiological, genetic and mechanistic research are important and will be enhanced by the stratification of patients using the <i>Allergy Diary</i></p> <p>Different levels of phenotype characterization (granularity) can be applied to assess phenotypic characterization in old age subjects</p>
Epidemiology	<p>In epidemiologic population studies, standardized definitions and tools are fundamental. The Allergy Diary allows novel approaches combining classical cross-sectional and longitudinal studies with real life studies in large populations</p>
Employers	<p>AR and asthma represent a major burden for the employers, and the estimated annual costs in the EU range from 30 to 60 B€. Better control of the disease was shown to reduce costs. The <i>Allergy Diary</i> has the potential to improve the control of allergic diseases and to significantly improve work productivity at the EU level</p>
Public health planning	<p>For public health purposes, a perfect patient characterization in real life is needed to identify the prevalence, burden and costs incurred by patients in order to improve quality of care and optimize health care planning and policies</p>
Reduction of inequities	<p>Inequities still exist in the EU for allergic diseases prevalence and burden (not only sex/gender inequities). POLLAR will attempt to understand them and to propose policies and health promotion strategies</p>

Abbreviations

AHA: active and healthy ageing; AIRWAYS ICPs: integrated care pathways for airway diseases; AR: allergic rhinitis; ARIA: Allergic Rhinitis and Its Impact on Asthma; CARAT: Control of Allergic Rhinitis and Asthma Test; CDSS: clinical decision support system; CNIL: Commission Informatique et Liberté; CRD: Chronic Respiratory Disease; DG CONNECT: Directorate General for Communications Networks, Content & Technology; DG Santé: Directorate General for Health and Food Safety; DG: Directorate General; EFA: European Federation

of Allergy and Airways Diseases Patients' Associations; EIP on AHA: European Innovation Partnership on AHA; EIP: European Innovation Partnership; EQ-5D: EuroQol; GARD: WHO Global Alliance against Chronic Respiratory Diseases; GDPR: General Data Protection Regulation; GIS: geographic information system; GP: Good Practice; GT: Google Trends; HCP: health care professional; ICP: integrated care pathway; IMS: Institute of Medical Science; JA-CHRODIS: Joint Action on Chronic Diseases and Promoting Healthy Ageing across the Life Cycle; MACVIA-LR: contre les MALadies Chroniques pour un Vieillissement Actif

(Fighting chronic diseases for AHA); MASK: Mobile Airways Sentinel network; MeDALL: Mechanisms of the Development of ALLergy (FP7); mHealth: mobile health; NCD: non-communicable disease; OTC: over the counter; PIA: privacy Impact Assessment; POLLAR: Impact of air POLLution on Asthma and Rhinitis; QOL: quality of life; SCUAD: severe chronic upper airway disease; TRL: technology readiness level; TWINNING: transfer of innovation of mobile technology; VAS: Visual Analogue Scale; WHO: World Health Organization; WPAI-AS: Work Productivity and Activity Questionnaire.

Authors' contributions

All authors are MAKs members and have contributed to the design of the project. Many authors also included users and disseminated the project in their own country. All authors read and approved the final manuscript.

Author details

¹ MACVIA-France, Fondation Partenariale FMC VIA-LR, CHRU Arnaud de Villeneuve, 371 Avenue du Doyen Gaston Giraud, Montpellier, France. ² INSERM U 1168, VIMA: Ageing and Chronic Diseases Epidemiological and Public Health Approaches, Villejuif, Université Versailles St-Quentin-en-Yvelines, UMR-S 1168, Montigny le Bretonneux, France. ³ Euforea, Brussels, Belgium. ⁴ KYomed-INNOV, Montpellier, France. ⁵ IQ4U Consultants Ltd, London, UK. ⁶ MedScript Ltd, Dundalk, Co Louth, Ireland. ⁷ Laboratoire HP2, Grenoble, INSERM, U1042, Université Grenoble Alpes, Grenoble, France. ⁸ CHU de Grenoble, Grenoble, France. ⁹ Conseil Général de l'Economie Ministère de l'Economie, de l'Industrie et du Numérique, Paris, France. ¹⁰ UCIBIO, REQUINTE, Faculty of Pharmacy and Competence Center on Active and Healthy Ageing, University of Porto (Porto4Ageing), Porto, Portugal. ¹¹ Center for Health Technology and Services Research- CINTESIS, Faculdade de Medicina, Universidade do Porto, Porto, Portugal. ¹² Medida, Lda, Porto, Portugal. ¹³ Faculty of Health Sciences and CICS – UBI, Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal. ¹⁴ Allergy Center, CUF Descobertas Hospital, Lisbon, Portugal. ¹⁵ Imunoalergologia, Centro Hospitalar Universitário de Coimbra and Faculty of Medicine, University of Coimbra, Coimbra, Portugal. ¹⁶ ProAR – Nucleo de Excelencia em Asma, Federal University of Bahia, Vitória da Conquista, Brazil. ¹⁷ WHO GARD Planning Group, Salvador, Brazil. ¹⁸ Allergy Service, University Hospital of Federal University of Santa Catarina (HU-UFSC), Florianópolis, Brazil. ¹⁹ Asthma Reference Center, Escola Superior de Ciências da Santa Casa de Misericórdia de Vitória, Vitória, Espírito Santo, Brazil. ²⁰ Division for Health Innovation, Campania Region and Federico II University Hospital Naples (R&D and DISMET), Naples, Italy. ²¹ CIRFF, Federico II University, Naples, Italy. ²² SOS Allergy and Clinical Immunology, USL Toscana Centro, Prato, Italy. ²³ Department of Medical Sciences, Allergy and Clinical Immunology Unit, University of Torino & Mauriziano Hospital, Torino, Italy. ²⁴ Consortium of Pharmacies and Services COSAFER, Salerno, Italy. ²⁵ Unit of Geriatric Immunoallergy, University of Bari Medical School, Bari, Italy. ²⁶ Department of Medicine, Surgery and Dentistry "Scuola Medica Salernitana", University of Salerno, Salerno, Italy. ²⁷ Center of Excellence in Asthma and Allergy, Hospital Médica Sur, México City, Mexico. ²⁸ Mexico City, Mexico. ²⁹ Puebla, Mexico. ³⁰ Ciudad Mexico, Mexico. ³¹ Allergy Department, Centre de l'Asthme et des Allergies Hôpital d'Enfants Armand-Trousseau (APHP), Paris, France. ³² UPMC Univ Paris 06, UMR_S 1136, Institut Pierre Louis d'Epidémiologie et de Santé Publique, Sorbonne Universités, Equipe EPAR, 75013 Paris, France. ³³ Epidemiology of Allergic and Respiratory Diseases, Department Institute Pierre Louis of Epidemiology and Public Health, INSERM, UPMC Sorbonne Université, Medical School Saint Antoine, Paris, France. ³⁴ La Rochelle, France. ³⁵ Department of Respiratory Diseases, Montpellier University Hospital, Montpellier, France. ³⁶ UPRES EA220, Pôle des Maladies des Voies Respiratoires, Hôpital Foch, Université Paris-Saclay, Suresnes, France. ³⁷ Reims, France. ³⁸ Division of Internal Medicine, Asthma and Allergy, Barlicki University Hospital, Medical University of Lodz, Lodz, Poland. ³⁹ Department of Prevention of Environmental Hazards and Allergy, Medical University of Warsaw, Warsaw, Poland. ⁴⁰ Clinic of Children's Diseases, and Institute of Health Sciences Department of Public Health, Vilnius University Institute of Clinical Medicine, Vilnius, Lithuania. ⁴¹ European Academy of Paediatrics (EAP/UEMS-SP), Brussels, Belgium. ⁴² Clinic of Children's Diseases, Faculty of Medicine, Vilnius University, Vilnius, Lithuania. ⁴³ Faculty of Medicine, Vilnius University, Vilnius, Lithuania. ⁴⁴ Woodbrook Medical Centre, Loughborough, UK. ⁴⁵ Allergy and Respiratory Research Group, Usher Institute of Population Health Sciences and Informatics,

University of Edinburgh, Medical School, Edinburgh, UK. ⁴⁶ Centre of Medical Informatics, Usher Institute of Population Health Sciences and Informatics, The University of Edinburgh, Edinburgh, UK. ⁴⁷ Allergy Unit, Department of Dermatology, University Hospital of Zurich, Zürich, Switzerland. ⁴⁸ Center for Rhinology and Allergy, Wiesbaden, Germany. ⁴⁹ Department of Otorhinolaryngology, Head and Neck Surgery, Universitätsmedizin Mannheim, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany. ⁵⁰ Comprehensive Allergy-Centre-Charité, Department of Dermatology and Allergy, Charité - Universitätsmedizin Berlin, Berlin, Germany. ⁵¹ Global Allergy and Asthma European Network (GA2LEN), Berlin, Germany. ⁵² Institute of Medical Statistics, and Computational Biology, Medical Faculty, University of Cologne, Cologne, Germany. ⁵³ CRI-Clinical Research International-Ltd, Hamburg, Germany. ⁵⁴ Department of Internal Medicine, Medical University of Graz, Graz, Austria. ⁵⁵ Department of ENT, Medical University of Graz, Graz, Austria. ⁵⁶ Department of Otorhinolaryngology, Academic Medical Center, Amsterdam, The Netherlands. ⁵⁷ Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, The Netherlands. ⁵⁸ ISGlobAL, Centre for Research in Environmental Epidemiology (CREAL), Barcelona, Spain. ⁵⁹ IMIM (Hospital del Mar Research Institute), Barcelona, Spain. ⁶⁰ CIBER Epidemiologia y Salud Pública (CIBERESP), Barcelona, Spain. ⁶¹ Universitat Pompeu Fabra (UPF), Barcelona, Spain. ⁶² Allergy Section, Department of Internal Medicine, Hospital Vall d'Hebron & ARADYAL Research Network, Barcelona, Spain. ⁶³ AQUAS, Barcelona, Spain. ⁶⁴ EUREGHA, European Regional and Local Health Association, Brussels, Belgium. ⁶⁵ Rhinology Unit and Smell Clinic, ENT Department, Hospital Clinic, University of Barcelona, Barcelona, Spain. ⁶⁶ Clinical and Experimental Respiratory Immunology, IDIBAPS, CIBERES, University of Barcelona, Barcelona, Spain. ⁶⁷ Skin and Allergy Hospital, Helsinki University Hospital, Helsinki, Finland. ⁶⁸ Association of Finnish Pharmacists, Helsinki, Finland. ⁶⁹ Department of Lung Diseases and Clinical Immunology, University of Turku, Turku, Finland. ⁷⁰ Terveystalo Allergy Clinic, Turku, Finland. ⁷¹ Department of Pulmonary Diseases, Cerrahpasa Faculty of Medicine, Istanbul University, Istanbul, Turkey. ⁷² Department of Pulmonary Diseases, Faculty of Medicine, Celal Bayar University, Manisa, Turkey. ⁷³ GARD Executive Committee, Manisa, Turkey. ⁷⁴ Center for Pediatrics and Child Health, Institute of Human Development, Royal Manchester Children's Hospital, University of Manchester, Manchester, UK. ⁷⁵ Allergy Department, 2nd Pediatric Clinic, Athens General Children's Hospital "P&A Kyriakou", University of Athens, 11527 Athens, Greece. ⁷⁶ Department of Otorhinolaryngology, University of Crete School of Medicine, Heraklion, Greece. ⁷⁷ Woolcock Institute of Medical Research, University of Sydney and Sydney Local Health District, Glebe, NSW, Australia. ⁷⁸ Department of Allergy, Immunology and Respiratory Medicine, Alfred Hospital and Central Clinical School, Monash University, Melbourne, VIC, Australia. ⁷⁹ Department of Immunology, Monash University, Melbourne, VIC, Australia. ⁸⁰ Servicio de Alergia e Inmunología, Clínica Santa Isabel, Buenos Aires, Argentina. ⁸¹ Director of Center of Allergy, Immunology and Respiratory Diseases, Santa Fe, Argentina Center for Allergy and Immunology, Santa Fe, Argentina. ⁸² Universidad Católica de Córdoba, Córdoba, Argentina. ⁸³ Department of Clinical Science and Education, Karolinska Institutet, Södersjukhuset, Stockholm, Sweden. ⁸⁴ Sachs' Children and Youth Hospital, Södersjukhuset, Stockholm, Sweden. ⁸⁵ Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden. ⁸⁶ Centre for Clinical Research Sörmland, Uppsala University, Eskilstuna, Sweden. ⁸⁷ Upper Airways Research Laboratory, ENT Department, Ghent University Hospital, Ghent, Belgium. ⁸⁸ Department of Otorhinolaryngology, Univ Hospitals Leuven, Louvain, Belgium. ⁸⁹ Academic Medical Center, University of Amsterdam, Amsterdam, The Netherlands. ⁹⁰ EFA European Federation of Allergy and Airways Diseases Patients' Associations, Brussels, Belgium. ⁹¹ Department of Dermatology and Allergy Centre, Odense University Hospital, Odense Research Center for Anaphylaxis (ORCA), Odense, Denmark. ⁹² Department of Medicine, Clinical Immunology and Allergy, McMaster University, Hamilton, ON, Canada. ⁹³ University Hospital Olomouc, Olomouc, Czech Republic. ⁹⁴ Peercode BV, Geldermalsen, The Netherlands. ⁹⁵ Faculty of Medicine, Transylvania University, Brasov, Romania. ⁹⁶ Division of Allergy/Immunology, University of South Florida, Tampa, USA. ⁹⁷ Section of Allergy and Immunology, Saint Louis University School of Medicine, Saint Louis, MO, USA. ⁹⁸ Johns Hopkins School of Medicine, Baltimore, MD, USA. ⁹⁹ Department of Otorhinolaryngology, Chiba University Hospital, Chiba, Japan. ¹⁰⁰ Nova Southeastern University, Fort Lauderdale, Florida, USA.

Acknowledgements

None.

Mask Study Group

- J Bousquet¹⁻³, PW Hellings⁴, W Aberer⁵, I Agache⁶, CA Akdis⁷, M Akdis⁷, MR Alberti⁸, R Almeida⁹, F Amat¹⁰, R Angles¹¹, I Annesi-Maesano¹², U Ansoategui¹³, JM Antó¹⁴⁻¹⁷, S Arnauville¹⁸, E Asayag¹⁹, A Asarnoj²⁰, H Arshad²¹, F Avolio²², E Bacci²³, C Bachert²⁴, I Baiardini²⁵, C Barabara²⁶, M Barbagallo²⁷, I Baroni²⁸, BA Barreto²⁹, X Basagana¹⁴, ED Bateman³⁰, M Bedolla-Barajas³¹, A Bedbrook², M Bewick³², B Beghé³³, EH Bel³⁴, KC Bergmann³⁵, KS Bennoor³⁶, M Benson³⁷, L Bertorello³⁸, AZ Białoszewski³⁸, T Bieber³⁹, S Bialek⁴⁰, C Bindsløv-Jensen⁴¹, L Bjermer⁴², H Blain^{43,44}, F Blasi⁴⁵, A Blua⁴⁶, M Bochenska Marciniak⁴⁷, I Bogus-Buczynska⁴⁷, AL Boner⁴⁸, M Bonini⁴⁹, S Bonini⁵⁰, CS Bosnic-Anticevich⁵¹, I Bosse⁵², J Bouchard⁵³, LP Boulet⁵⁴, R Bourret⁵⁵, PJ Bousquet¹², F Braidão²⁵, V Briedis⁵⁶, CE Brightling⁵⁷, J Brozek⁵⁸, C Bucca⁵⁹, R Buhl⁶⁰, R Buonaiuti⁶¹, C Panaitescu⁶², MT Burguete Cabañas⁶³, E Burté³, A Bush⁶⁴, F Caballero-Fonseca⁶⁵, D Caillot⁶⁷, D Caimmi⁶⁸, MA Calderon⁶⁹, PAM Camargos⁷⁰, T Camuzat⁷¹, G Canfora⁷², GW Canonica²⁵, V Cardona⁷³, KH Carlsen⁷⁴, P Carreiro-Martins⁷⁵, AM Carrazzo⁷⁶, W Carr⁷⁷, C Cartier⁷⁸, T Casale⁷⁹, G Castellano⁸⁰, L Cecchi⁸¹, AM Cepeda⁸², NH Chavannes⁸³, Y Chen⁸⁴, R Chiron⁶⁸, T Chivato⁸⁵, E Chkhartishvili⁸⁶, AG Chuchalin⁸⁷, KF Chung⁸⁸, MM Ciaravolo⁸⁹, A Ciceran⁹⁰, C Cingi⁹¹, G Ciprandi⁹², AC Carvalho Coelho⁹³, L Colas⁹⁴, E Colgan⁹⁵, J Coll⁹⁶, D Conforti⁹⁷, J Correia de Sousa⁹⁸, RM Cortés-Grimaldo⁹⁹, F Corti¹⁰⁰, E Costa¹⁰¹, MC Costa-Dominguez¹⁰², AL Courbis¹⁰³, L Cox¹⁰⁴, M Crescenzo¹⁰⁵, AA Cruz¹⁰⁶, A Custovic¹⁰⁷, W Czarlewski¹⁰⁸, SE Dahlen¹⁰⁹, C Dario¹¹⁰, J da Silva¹¹¹, Y Dauvilliers¹¹², U Darsow¹¹³, F De Blay¹¹⁴, G De Carlo¹¹⁵, T Dedeu¹¹⁶, M de Fátima Emerson¹¹⁷, G De Feo¹¹⁸, G De Vries¹¹⁹, B De Martino¹²⁰, N De Paula Motta Rubini¹²¹, D Deleau¹²², P Demoly^{126,8}, JA Denburg¹²³, P Devillier¹²⁴, S Di Capua Ercolano¹²⁵, N Di Carlucio⁶⁶, A Didier¹²⁶, D Dokic¹²⁷, MG Dominguez-Silva¹²⁸, H Douagui¹²⁹, G Dray¹⁰³, R Dubakienė¹³⁰, SR Durham¹³¹, G Du Toit¹³², MS Dykewicz¹³³, Y El-Gamal¹³⁴, P Eklund¹³⁵, E Eller⁴¹, R Emuzyte¹³⁶, J Farrell⁹⁵, A Farsi⁸¹, J Ferreira de Mello Jr¹³⁷, J Ferrero¹³⁸, A Fink-Wagner¹³⁹, A Fiocchi¹⁴⁰, WJ Fokkens¹⁴¹, JA Fonseca¹⁴², JF Fontaine¹⁴³, S Forti⁹⁷, JM Fuentes-Perez¹⁴⁴, JL Gálvez-Romero¹⁴⁵, A Gamkrelidze¹⁴⁶, J García-Aymerich¹⁴, CY García-Cobas¹⁴⁷, MH Garcia-Cruz¹⁴⁸, B Gemicioğlu¹⁴⁹, S Genova¹⁵⁰, C George¹⁵¹, JE Gereda¹⁵², R Gerth van Wijk¹⁵³, RM Gomez¹⁵⁴, J Gómez-Vera¹⁵⁵, S González Díaz¹⁵⁶, M Gotua¹⁵⁷, I Grisle¹⁵⁸, M Guidacci¹⁵⁹, NA Guldemond¹⁶⁰, Z Gutter¹⁶¹, MA Guzmán¹⁶², T Haahela¹⁶³, J Hajjam¹⁶⁴, L Hernández¹⁶⁵, JOB Hourihane¹⁶⁶, YR Huerta-Villalobos¹⁶⁷, M Humbert¹⁶⁸, G Iaccarino¹⁶⁹, M Illario¹⁷⁰, JC Ivancevich¹⁷¹, EJ Jares¹⁷², E Jasssem¹⁷³, SL Johnston¹⁷⁴, G Joos¹⁷⁵, KS Jung¹⁷⁶, M Jutel¹⁷⁷, I Kaidashev¹⁷⁸, O Kalayci¹⁷⁹, AF Kalyoncu¹⁸⁰, J Karjalainen¹⁸¹, P Kardas¹⁸², T Keil¹⁸³, PK Keith¹⁸⁴, M Khaïtov¹⁸⁵, N Khtaev¹⁸⁶, J Kleine-Tebbe¹⁸⁷, L Klidas¹⁸⁸, ML Kowalski¹⁸⁹, M Kuitunen¹⁹⁰, I Kull¹⁹¹, P Kuna⁴⁷, M Kupczyk¹⁹⁴, V Kvedariene¹⁹², E Krzych-Falta¹⁹³, P Lacwik⁴⁷, D Larenas-Linnemann¹⁹⁴, D Laune¹⁸, D Lauri¹⁹⁵, J Lavrut¹⁹⁶, LTT Le¹⁹⁷, M Lessa¹⁹⁸, G Levato¹⁹⁹, J Li²⁰⁰, P Lieberman²⁰¹, A Lipiec¹⁹³, B Lipworth²⁰², KC Lodrup Carlsen²⁰³, R Louis²⁰⁴, O Lourenço²⁰⁵, JA Luna-Pech²⁰⁶, K Maciej⁴⁷, A Magnan⁹⁴, B Mahboub²⁰⁷, D Maier²⁰⁸, A Mai²⁰⁹, I Majer²¹⁰, J Malva²¹¹, E Mandajieva²¹², P Manning²¹³, E De Manuel Keenoy²¹⁴, GD Marshall²¹⁵, MR Masjedi²¹⁶, JF Maspero²¹⁷, E Mathieu-Dupas¹⁸, JJ Matta Campos²¹⁸, AL Matos²¹⁹, M Maurer²²⁰, S Mavale-Manuel²²¹, O Mayora⁹⁷, MA Medina-Avalos²²², E Melén²²³, F Melo-Gomes²⁶, EO Meltzer²²⁴, E Menditto²²⁵, J Mercier²²⁶, N Miculnicu²²⁷, F Mihaltan²²⁸, B Milenkovic²²⁹, G Moda²³⁰, MD Mogica-Martinez²³¹, Y Mohammad²³², I Momas^{233,234}, S Montefort²³⁵, R Monti²³⁶, D Mora Bogado²³⁷, M Morais-Almeida²³⁸, FF Morato-Castro²³⁹, R Mösges²⁴⁰, A Mota-Pinto²⁴¹, P Moura Santo²⁴², J Mullol²⁴³, L Münter²⁴⁴, A Muraro²⁴⁵, R Murray²⁴⁶, R Naclerio²⁴⁷, R Nadif³, N Nalin²⁸, L Napoli²⁴⁸, L Namazova-Baranova²⁴⁹, H Neffen²⁵⁰, V Niedeberger²⁵¹, K Nekam²⁵², A Neou²⁵³, A Nieto²⁵⁴, L Nogueira-Silva²⁵⁵, M Nogues^{2,256}, E Novellino²⁵⁷, TD Nyembue²⁵⁸, RE O'Hehir²⁵⁹, C Odzhakova²⁶⁰, K Ohta²⁶¹, Y Okamoto²⁶², K Okubo²⁶³, GL Onorato², M Ortega Cisneros²⁶⁴, S Ouedraogo²⁶⁵, I Pali-Schöli²⁶⁶, S Palkonen¹¹⁵, P Panzner²⁶⁷, NG Papadopoulos²⁶⁸, HS Park²⁶⁹, A Papi²⁷⁰, G Passalacqua²⁷¹, E Paulino²⁷², R Pawankar²⁷³, S Pedersen²⁷⁴, JL Pépin²⁷⁵, AM Pereira²⁷⁶, M Persico²⁷⁷, O Pfaar^{278,279}, J Phillips²⁸⁰, R Picard²⁸¹, B Pigearias²⁸², I Pin²⁸³, C Pitsios²⁸⁴, D Plavec²⁸⁵, W Pohl²⁸⁶, TA Popov²⁸⁷, F Portejoie², P Potter²⁸⁸, AC Pozzi²⁸⁹, D Price²⁹⁰, EP Prokopakis²⁹¹, R Puy²⁵⁹, B Pugin²⁹², RE Pulido Ross²⁹³, M Przemacka⁴⁷, KF Rabe²⁹⁴, F Raciborski¹⁹³, R Rajabian-Soderlund²⁹⁵, S Reitsma¹⁴¹, I Ribeiro²⁹⁶, J Rimmer²⁹⁷, D Rivero-Yeverino²⁹⁸, JA Rizzo²⁹⁹, MC Rizzo³⁰⁰, C Robalo-Cordeiro³⁰¹, F Rodenas³⁰², X Rodo¹⁴, M Rodriguez Gonzalez³⁰³, L Rodriguez-Mañas³⁰⁴, C Rolland³⁰⁵, S Rodrigues Valle³⁰⁶, M Roman Rodriguez³⁰⁷, A Romano³⁰⁸, E Rodriguez-Zagal³⁰⁹, G Rolla³¹⁰, RE Roller-Wirnsberger³¹¹, M Romano²⁸, J Rosado-Pinto³¹², N Rosario³¹³, M Rottem³¹⁴, D Ryan³¹⁵, H Sagara³¹⁶, J Salimäki³¹⁷, B Samolinski¹⁹³, M Sanchez-Borges³¹⁸, J Sastre-Dominguez³¹⁹, GK Scadding³²⁰, HJ Schunemann⁵⁸, N Scichilone³²¹, P Schmid-Grendelmeier³²², FS Serpa³²³, S Shamai²⁴⁰, A Sheikh³²⁴, M Sierra³⁶, FER Simons³²⁵, V Siroux³²⁶, JC Sisul³²⁷, I Skirndo³⁷⁸, D Solé³²⁸, D Somekh³²⁹, M Sondermann³³⁰, T Sooronbaev³³¹, M Sova³³², M Sorensen³³³, M Sorlini³³⁴, O Spranger¹³⁹, C Stellato¹¹⁸, R Stelmach³³⁵, R Stukas³³⁶, J Sunyer¹⁴⁻¹⁷, J Strozek¹⁹³, A Szylling¹⁹³, JN Tebyricá³³⁷, M Thibaudon³³⁸, T To³³⁹, A Todo-Bom³⁴⁰, PV Tomazic³⁴¹, S Toppila-Salmi¹⁶³, U Trama³⁴², M Triggiani¹¹⁸, C Suppli Ulrik³⁴³, M Urrutia-Pereira³⁴⁴, R Valenta³⁴⁵, A Valero³⁴⁶, A Valiulis³⁴⁷, E Valovirta³⁴⁸, M van Eerd¹¹⁹, E van Ganse³⁴⁹, M van Hage³⁵⁰, O Vandenplas³⁵¹, MT Ventura³⁵², G Vezzani³⁵³, T Vasankari³⁵⁴, A Vatrella¹¹⁸, MT Verissimo²¹¹, F Viart⁷⁸, G Vieg³⁵⁵, D Vicheva³⁵⁶, T Vontetsianos³⁵⁷, M Wagenmann³⁵⁸, S Walker³⁵⁹, D Wallace³⁶⁰, DY Wang³⁶¹, S Wasserman³⁶², T Werfel³⁶³, M Westman³⁶⁴, M Wickman¹⁹¹, DM Williams³⁶⁵, S Williams³⁶⁶, N Wilson, J Wright³⁶⁷, P Wroczyński⁴⁰, P Yakovliev³⁶⁸, BP Yawn³⁶⁹, PK Yiallourou³⁷⁰, A Yorgancioglu³⁷¹, OM Yusuf³⁷², HJ Zar³⁷³, L Zhang³⁷⁴, N Zhong²⁰⁰, ME Zernotti³⁷⁵, M Zidam³⁷⁶, T Zuberbier³⁵, C Zubrinich²⁵⁹, A Zurkühlen³⁷⁷
- ¹University Hospital, Montpellier, France. ²MACVIA-France, Fondation partenariaire FMC VIA-LR, Montpellier, France. ³VIMA. INSERM U 1168, VIMA : Ageing and chronic diseases Epidemiological and public health approaches, Villejuif, Université Versailles St-Quentin-en-Yvelines, UMR-S 1168, Montigny le Bretonneux, France and Euforea, Brussels, Belgium. ⁴Laboratory of Clinical Immunology, Department of Microbiology and Immunology, KU Leuven, Leuven, Belgium. ⁵Department of Dermatology, Medical University of Graz, Graz, Austria. ⁶Transylvania University Brasov, Brasov, Romania. ⁷Swiss Institute of Allergy and Asthma Research (SIAF), University of Zurich, Davos, Switzerland. ⁸Project Manager, Chairman of the Council of Municipality of Salerno, Italy. ⁹Center for Health Technology and Services Research- CINTESIS, Faculdade de Medicina, Universidade do Porto; and Medida, Lda Porto, Portugal. ¹⁰Allergology department, Centre de l'Asthme et des Allergies Hôpital d'Enfants Armand-Trousseau (APHP); Sorbonne Université, UPMC Univ Paris 06, UMR_S 1136, Institut Pierre Louis d'Epidémiologie et de Santé Publique, Equipe EPAR, Paris, France. ¹¹Innovación y nuevas tecnologías, Salud Sector sanitario de Barbastro, Barbastro, Spain. ¹²Epidemiology of Allergic and Respiratory Diseases, Department Institute Pierre Louis of Epidemiology and Public Health, INSERM and Sorbonne Université, Medical School Saint Antoine, Paris, France. ¹³Department of Allergy and Immunology, Hospital Quirón Bizkaia, Erandio, Spain. ¹⁴ICREA (Climate and Health (CLIMA) Program, ICGlobal, Barcelona, Spain. ¹⁵IMIM (Hospital del Mar Research Institute), Barcelona, Spain. ¹⁶CIBER Epidemiología y Salud Pública (CIBERESP), Barcelona, Spain. ¹⁷Universitat Pompeu Fabra (UPF), Barcelona, Spain. ¹⁸Kyomed INNOV, Montpellier, France. ¹⁹Argentine Society of Allergy and Immunopathology, Buenos Aires, Argentina. ²⁰Clinical Immunology and Allergy Unit, Department of Medicine Solna, Karolinska Institutet, Stockholm, and Astrid Lindgren Children's Hospital, Department of Pediatric Pulmonology and Allergy, Karolinska University Hospital, Stockholm, Sweden. ²¹David Hide Asthma and Allergy Research Centre, Isle of Wight, United Kingdom. ²²Regione Puglia, Bari, Italy. ²³Regione Liguria, Genoa, Italy. ²⁴Upper Airways Research Laboratory, ENT Dept, Ghent University Hospital, Ghent, Belgium. ²⁵Allergy and Respiratory Diseases, Ospedale Policlinico San Martino, University of Genoa, Italy. ²⁶PNDR, Portuguese National Programme for Respiratory Diseases, Faculdade de Medicina de Lisboa, Lisbon, Portugal. ²⁷Director of the Geriatric Unit, Department of Internal Medicine (DIBIMIS), University of Palermo, Italy. ²⁸Telbios SRL, Milan, Italy. ²⁹Universidade do Estado do Pará, Belem, Brazil. ³⁰Department of Medicine, University of Cape Town, Cape Town, South Africa. ³¹Hospital Civil de Guadalajara Dr Juan I Menchaca, Guadalajara, Mexico. ³²IQ4U Consultants Ltd, London, UK. ³³Section of Respiratory Disease, Department of Oncology, Haematology and Respiratory Diseases, University of Modena and Reggio Emilia, Modena, Italy. ³⁴Department of Respiratory Medicine, Academic Medical Center (AMC), University of Amsterdam, The Netherlands. ³⁵Comprehensive Allergy Center Charité, Department of Dermatology and Allergy, Charité - Universitätsmedizin Berlin; Global Allergy and Asthma European Network (GA²LEN), Berlin, Germany. ³⁶Dept of Respiratory Medicine, National Institute of Diseases of the Chest and Hospital, Dhaka, Bangladesh. ³⁷Centre for Individualized Medicine, Department of Pediatrics, Faculty of Medicine, Linköping, Sweden. ³⁸Department of Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Poland. ³⁹BIEBER. Department of Dermatology and Allergy, Rheinische Friedrich-Wilhelms-University Bonn, Bonn, Germany. ⁴⁰Dept of Biochemistry and Clinical Chemistry, Faculty of Pharmacy with the Division of Laboratory Medicine, Warsaw Medical University, Warsaw, Poland. ⁴¹Department of Dermatology and Allergy Centre, Odense University Hospital, Odense Research Center for Anaphylaxis (ORCA), Odense, Denmark. ⁴²Department of Respiratory Medicine and Allergology, University Hospital, Lund, Sweden.

- ⁴³Department of Geriatrics, Montpellier University Hospital, Montpellier, France. ⁴⁴EA 2991, Euromov, University Montpellier, France. ⁴⁵Department of Pathophysiology and Transplantation, University of Milan, IRCCS Fondazione Ca'Granda Ospedale Maggiore Policlinico, Milan, Italy. ⁴⁶Argentine Association of Respiratory Medicine, Buenos Aires, Argentina. ⁴⁷Division of Internal Medicine, Asthma and Allergy, Barlicki University Hospital, Medical University of Lodz, Poland. ⁴⁸Pediatric Department, University of Verona Hospital, Verona, Italy. ⁴⁹Department of Public Health and Infectious Diseases, Sapienza University of Rome, Italy. ⁵⁰Second University of Naples and Institute of Translational Medicine, Italian National Research Council. ⁵¹Woolcock Institute of Medical Research, University of Sydney and Woolcock Emphysema Centre and Sydney Local Health District, Glebe, NSW, Australia. ⁵²Allergist, La Rochelle, France. ⁵³Associate professor of clinical medicine, Laval's University, Quebec city, Head of medicine department, Hôpital de la Malbaie, Quebec, Canada. ⁵⁴Quebec Heart and Lung Institute, Laval University, Québec City, Quebec, Canada. ⁵⁵Centre Hospitalier Valenciennes, France. ⁵⁶Head of Department of Clinical Pharmacy of Lithuanian University of Health Sciences, Kaunas, Lithuania. ⁵⁷Institute of Lung Health, Respiratory Biomedical Unit, University Hospitals of Leicester NHS Trust, Leicestershire, UK; Department of Infection, Immunity and Inflammation, University of Leicester, Leicester, UK. ⁵⁸Department of Health Research Methods, Evidence and Impact, Division of Immunology and Allergy, Department of Medicine, McMaster University, Hamilton, ON, Canada. ⁵⁹Chief of the University Pneumology Unit- AOU Molinette, Hospital City of Health and Science of Torino, Italy. ⁶⁰Universitätsmedizin der Johannes Gutenberg-Universität Mainz, Mainz, Germany. ⁶¹Pharmacist, Municipality Pharmacy, Sarno, Italy. ⁶²University of Medicine and Pharmacy Victor Babes, Timisoara, Romania. ⁶³Instituto de Pediatria, Hospital Zambrano Hellion Tec de Monterrey, Monterrey, Mexico. ⁶⁴Imperial College and Royal Brompton Hospital, London, UK. ⁶⁵Centro Medico Docente La Trinidad, CaRacas, Venezuela. ⁶⁶Regional Director Assofarm Campania and Vice President of the Board of Directors of Cofaser, Salerno, Italy. ⁶⁷Service de pneumologie, CHU et université d'Auvergne, Clermont-Ferrand, France. ⁶⁸Department of Respiratory Diseases, Montpellier University Hospital, France. ⁶⁹Imperial College London - National Heart and Lung Institute, Royal Brompton Hospital NHS, London, UK. ⁷⁰Federal University of Minas Gerais, Medical School, Department of Pediatrics, Belo Horizonte, Brazil. ⁷¹Assitant Director General, Montpellier, Région Occitanie, France. ⁷²Mayor of Sarno and President of Salerno Province, Director, Anesthesiology Service, Sarno "Martiri del Villa Malta" Hospital, Italy. ⁷³Allergy Section, Department of Internal Medicine, Hospital Vall d'Hebron & ARADyAL Spanish Research Network, Barcelona, Spain. ⁷⁴Department of Paediatrics, Oslo University Hospital and University of Oslo, Oslo, Norway. ⁷⁵CEDOC, Integrated Pathophysiological Mechanisms Research Group, Nova Medical School, Campo dos Martires da Patria, Lisbon, and Serviço de Imunoalergologia, Centro Hospitalar de Lisboa Central, EPE, Lisbon, Portugal. ⁷⁶Regional Ministry of Health of Andalusia, Seville, Spain. ⁷⁷Allergy and Asthma Associates of Southern California, Mission Viejo, CA, USA. ⁷⁸ASA - Advanced Solutions Accelerator, Clapiers, France. ⁷⁹Division of Allergy/Immunology, University of South Florida, Tampa, FL, USA. ⁸⁰Celentano pharmacy, Massa Lubrense, Italy. ⁸¹SOS Allergy and Clinical Immunology, USL Toscana Centro, Prato, Italy. ⁸²Allergy and Immunology Laboratory, Metropolitan University Hospital, Branquilla, Columbia. ⁸³Department of Public Health and Primary Care, Leiden University Medical Center, Leiden, The Netherlands. ⁸⁴Capital Institute of Pediatrics, Chaoyang district, Beijing, China. ⁸⁵School of Medicine, University CEU San Pablo, Madrid, Spain. ⁸⁶David Tvildiani Medical University - ALETI Highest Medical School, David Tatishvili Medical Center Tbilisi, Georgia. ⁸⁷Pulmonology Research Institute FMBA, Moscow, Russia and GARD Executive Committee, Moscow, Russia. ⁸⁸National Heart & Lung Institute, Imperial College, London, UK. ⁸⁹Specialist social worker, Sorrento, Italy. ⁹⁰Argentine Federation of Otorhinolaryngology Societies, Buenos Aires, Argentina. ⁹¹Eskisehir Osmangazi University, Medical Faculty, ENT Department, Eskisehir, Turkey. ⁹²Medicine Department, IRCCS-Azienda Ospedaliera Universitaria San Martino, Genoa, Italy. ⁹³Universidade Federal da Bahia, Escola de Enfermagem, Brazil. ⁹⁴Plateforme Transversale d'Allergologie, Institut du Thorax, CHU de Nantes, Nantes, France. ⁹⁵LANUA International Healthcare Consultancy, Northern Ireland, UK. ⁹⁶Innovación y nuevas tecnologías, Salud Sector sanitario de Barbastro, Barbastro, Spain. ⁹⁷Innovation and Research Office, Department of Health and Social Solidarity, Autonomous Province of Trento, Italy. ⁹⁸Life and Health Sciences Research Institute (ICVS), School of Medicine, University of Minho, Braga, Portugal; ICVS/3B's, PT Government Associate Laboratory, Braga/Guimarães, Portugal. ⁹⁹Guadalajara, Mexico. ¹⁰⁰FIMMG (Federazione Italiana Medici di Medicina Generale), Milan, Italy. ¹⁰¹UCIBIO, REQUINTE, Faculty of Pharmacy and Competence Center on Active and Healthy Ageing of University of Porto (Porto4Ageing), Porto, Portugal. ¹⁰²Mexico City, Mexico. ¹⁰³IMT Mines Alès, Université Montpellier, Alès, France. ¹⁰⁴Department of Medicine, Nova Southeastern University, Davie, University of Miami Dept of Medicine, Miami, Florida, USA. ¹⁰⁵Regional Director Assofarm Campania and Vice President of the Board of Directors of Cofaser, Salerno, Italy. ¹⁰⁶ProAR - Nucleo de Excelencia em Asma, Federal University of Bahia, Brasil and WHO GARD Planning Group, Brazil. ¹⁰⁷Centre for Respiratory Medicine and Allergy, Institute of Inflammation and Repair, University of Manchester and University Hospital of South Manchester, Manchester, UK. ¹⁰⁸Medical Consulting Czarlewski, Levallois, France. ¹⁰⁹The Centre for Allergy Research, The Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden. ¹¹⁰Azienda Provinciale per i Servizi Sanitari di Trento (APSS-Trento), Italy. ¹¹¹Department of Internal Medicine, Federal University of Santa Catarina, Trindade, Florianópolis, Santa Catarina, Brazil. ¹¹²Sleep Unit, Department of Neurology, Hôpital Gui-de-Chauliac Montpellier, Inserm U1061, France. ¹¹³Department of Dermatology and Allergy, Technische Universität München, Munich, Germany; ZAUM-Center for Allergy and Environment, Helmholtz Center Munich, Technische Universität München, Munich, Germany. ¹¹⁴Allergy Division, Chest Disease Department, University Hospital of Strasbourg, Strasbourg, France. ¹¹⁵EFA European Federation of Allergy and Airways Diseases Patients' Associations, Brussels, Belgium. ¹¹⁶AQuAS, Barcelona, Spain & EUREGHA, European Regional and Local Health Association, Brussels, Belgium. ¹¹⁷Policlínica Geral do Rio de Janeiro, Rio de Janeiro - Brasil. ¹¹⁸Department of Medicine, Surgery and Dentistry "Scuola Medica Salernitana", University of Salerno, Salerno, Italy. ¹¹⁹Peercode BV, Geldermalsen, The Netherlands. ¹²⁰Social workers coordinator, Sorrento, Italy. ¹²¹Federal University of the State of Rio de Janeiro, School of Medicine and Surgery, Rio de Janeiro, Brazil. ¹²²Allergology and Immunology Discipline, "Iuliu Hatieganu" University of Medicine and Pharmacy, Cluj-Napoca, Romania. ¹²³Department of Medicine, Division of Clinical Immunology and Allergy, McMaster University, Hamilton, Ontario, Canada. ¹²⁴Laboratoire de Pharmacologie Respiratoire UPRES EA220, Hôpital Foch, Suresnes, Université Versailles Saint-Quentin, Université Paris Saclay, France. ¹²⁵Farmacie Dei Golfi Group, Massa Lubrense, Italy. ¹²⁶Rangueil-Larrey Hospital, Respiratory Diseases Department, Toulouse, France. ¹²⁷University Clinic of Pulmology and Allergy, Medical Faculty Skopje, R Macedonia. ¹²⁸Mexico City, Mexico. ¹²⁹Service de Pneumo-Allergologie, Centre Hospitalo-Universitaire de Béni-Messous, Algiers, Algeria. ¹³⁰Clinic of infectious, chest diseases, dermatology and allergology, Vilnius University, Vilnius, Lithuania. ¹³¹Allergy and Clinical Immunology National Heart and Lung Institute, Imperial College London, UK. ¹³²Guy's and St Thomas' NHS Trust, Kings College London, UK. ¹³³Section of Allergy and Immunology, Saint Louis University School of Medicine, Saint Louis, Missouri, USA. ¹³⁴Pediatric Allergy and Immunology Unit, Children's Hospital, Ain Shams University, Cairo, Egypt. ¹³⁵Department of Computing Science, Umeå University, Sweden and Four Computing Oy, Finland. ¹³⁶Clinic of Children's Diseases, Faculty of Medicine, Vilnius University, Vilnius, Lithuania. ¹³⁷University of São Paulo Medical School, São Paulo, Brazil. ¹³⁸Andalusian Agency for Healthcare Quality, Seville, Spain. ¹³⁹Global Allergy and Asthma Platform GAAPP, Vienna, Austria. ¹⁴⁰Division of Allergy, Department of Pediatric Medicine - The Bambino Gesù Children's Research Hospital Holy see, Rome, Italy. ¹⁴¹Department of Otorhinolaryngology, Amsterdam, University Medical Centres, AMC, Amsterdam the Netherlands. ¹⁴²CINTESIS, Center for Research in Health Technologies and Information Systems, Faculdade de Medicina da Universidade do Porto, Porto, Portugal and MEDIDA, Lda, Porto, Portugal. ¹⁴³Allergist, Reims, France. ¹⁴⁴Hospital general regional 1 "Dr Carlos Mc Gregor Sanchez Navarro" IMSS, Mexico City, Mexico. ¹⁴⁵Regional hospital of ISSSTE, Puebla, Mexico. ¹⁴⁶National Center for Disease Control and Public Health of Georgia, Tbilisi, Georgia. ¹⁴⁷Guadalajara, Mexico. ¹⁴⁸Allergy Clinic, National Institute of Respiratory Diseases, Mexico City, Mexico. ¹⁴⁹Department of Pulmonary Diseases, Istanbul University-Cerrahpasa, Cerrahpasa Faculty of Medicine, Istanbul, Turkey. ¹⁵⁰Allergology unit, UHATEM "NIPirogov", Sofia, Bulgaria. ¹⁵¹Medical University, Faculty of Public Health, Sofia. ¹⁵²Allergy and Immunology Division, Clinica Ricardo Palma, Lima, Peru. ¹⁵³Department of Internal Medicine, section of Allergology, Erasmus MC, Rotterdam, The Netherlands. ¹⁵⁴Allergy & Asthma Unit, Hospital San Bernardo Salta, Argentina. ¹⁵⁵Allergy Clinic, Hospital Regional del ISSSTE Lic. López Mateos, Mexico City, Mexico. ¹⁵⁶Head and Professor, Centro Regional de Excelencia CONACYT y WAO en Alergia, Asma e Inmunología, Hospital Universitario, Universidad Autónoma de Nuevo León, Monterrey NL, Mexico. ¹⁵⁷Center of Allergy and Immunology, Georgian Association of Allergology

- and Clinical Immunology, Tbilisi, Georgia. ¹⁵⁸Latvian Association of Allergists, Center of Tuberculosis and Lung Diseases, Riga, Latvia. ¹⁵⁹Federal District Base Hospital Institute, Brasília, Brazil. ¹⁶⁰Institute of Health Policy and Management iBMG, Erasmus University, Rotterdam, The Netherlands. ¹⁶¹University Hospital Olomouc – National eHealth Centre, Czech Republic. ¹⁶²Immunology and Allergy Division, Clinical Hospital, University of Chile, Santiago, Chile. ¹⁶³Skin and Allergy Hospital, Helsinki University Hospital, University of Helsinki, Helsinki, Finland. ¹⁶⁴Centich : centre d'expertise nationale des technologies de l'information et de la communication pour l'autonomie, Gérotopôle autonomie longévité des Pays de la Loire, Conseil régional des Pays de la Loire, Centre d'expertise Partenariat Européen d'Innovation pour un vieillissement actif et en bonne santé, Nantes, France. ¹⁶⁵Autonomous University of Baja California, Ensenada, Baja California, Mexico. ¹⁶⁶Department of Paediatrics and Child Health, University College Cork, Cork, Ireland. ¹⁶⁷Hospital General Regional 1 "Dr. Carlos MacGregor Sánchez Navarro" IMSS, Mexico City, Mexico. ¹⁶⁸Université Paris-Sud; Service de Pneumologie, Hôpital Bicêtre; Inserm UMR_S999, Le Kremlin Bicêtre, France. ¹⁶⁹Dipartimento di medicina, chirurgia e odontoiatria, università di Salerno, Italy. ¹⁷⁰Division for Health Innovation, Campania Region and Federico II University Hospital Naples (R&D and DISMET) Naples, Italy. ¹⁷¹Servicio de Alergia e Immunología, Clínica Santa Isabel, Buenos Aires, Argentina. ¹⁷²President, Libra Foundation, Buenos Aires, Argentina. ¹⁷³Medical University of Gdańsk, Department of Allergology, Gdansk, Poland. ¹⁷⁴Airway Disease Infection Section, National Heart and Lung Institute, Imperial College; MRC & Asthma UK Centre in Allergic Mechanisms of Asthma, London, UK. ¹⁷⁵Dept of Respiratory Medicine, Ghent University Hospital, Ghent, Belgium. ¹⁷⁶Hallym University College of Medicine, Hallym University Sacred Heart Hospital, Gyeonggi-do, South Korea. ¹⁷⁷Department of Clinical Immunology, Wrocław Medical University, Poland. ¹⁷⁸Ukrainian Medical Stomatological Academy, Poltava, Ukraine. ¹⁷⁹Pediatric Allergy and Asthma Unit, Hacettepe University School of Medicine, Ankara, Turkey. ¹⁸⁰Hacettepe University, School of Medicine, Department of Chest Diseases, Immunology and Allergy Division, Ankara, Turkey. ¹⁸¹Allergy Centre, Tampere University Hospital, Tampere, Finland. ¹⁸²First Department of Family Medicine, Medical University of Lodz, Poland. ¹⁸³Institute of Social Medicine, Epidemiology and Health Economics, Charité – Universitätsmedizin Berlin, Berlin, and Institute for Clinical Epidemiology and Biometry, University of Würzburg, Germany. ¹⁸⁴Department of Medicine, McMaster University, HealthSciences Centre 3V47, West, Hamilton, Ontario, Canada. ¹⁸⁵National Research Center, Institute of Immunology, Federal Medicobiological Agency, Laboratory of Molecular immunology, Moscow, Russian Federation. ¹⁸⁶GARD Chairman, Geneva, Switzerland. ¹⁸⁷Allergy & Asthma Center Westend, Berlin, Germany. ¹⁸⁸Center for Rhinology and Allergology, Wiesbaden, Germany. ¹⁸⁹Department of Immunology and Allergy, Healthy Ageing Research Center, Medical University of Lodz, Lodz, Poland. ¹⁹⁰Children's Hospital and University of Helsinki, Finland. ¹⁹¹Centre for Clinical Research Sörmaland, Uppsala University, Eskilstuna, Sweden. ¹⁹²Faculty of Medicine, Vilnius University, Vilnius, Lithuania. ¹⁹³Department of Prevention of Environmental Hazards and Allergology, Medical University of Warsaw, Poland. ¹⁹⁴Center of Excellence in Asthma and Allergy, Médica Sur Clinical Foundation and Hospital, México City, Mexico. ¹⁹⁵Presidente CMMC, Milano, Italy. ¹⁹⁶Head of the Allergy Department of Pedro de Elizalde Children's Hospital, Buenos Aires, Argentina. ¹⁹⁷University of Medicine and Pharmacy, Hochiminh City, Vietnam. ¹⁹⁸Federal University of Bahia, Brazil. ¹⁹⁹Sifmed, Milano, Italy. ²⁰⁰State Key Laboratory of Respiratory Diseases, Guangzhou Institute of Respiratory Disease, the First Affiliated Hospital of Guangzhou Medical University, Guangzhou, China. ²⁰¹Departments of Internal Medicine and Pediatrics (Divisions of Allergy and Immunology), University of Tennessee College of Medicine, Germantown, TN, USA. ²⁰²Scottish Centre for Respiratory Research, Cardiovascular & Diabetes Medicine, Medical Research Institute, Ninewells Hospital, University of Dundee, UK. ²⁰³Oslo University Hospital, Department of Paediatrics, Oslo, and University of Oslo, Faculty of Medicine, Institute of Clinical Medicine, Oslo, Norway. ²⁰⁴Department of Pulmonary Medicine, CHU Sart-Tilman, and GIGA I3 research group, Liege, Belgium. ²⁰⁵Faculty of Health Sciences and CICS – UBI, Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal. ²⁰⁶Department of Philosophical, Methodological and Instrumental Disciplines, CUCS, University of Guadalajara, Guadalajara, Mexico. ²⁰⁷Department of Pulmonary Medicine, Rashid Hospital, Dubai, UAE. ²⁰⁸Biomax Informatics AG, Munich, Germany. ²⁰⁹Director General for Health and Social Care, Scottish Government, Edinburgh, UK. ²¹⁰Department of Respiratory Medicine, University of Bratislava, Bratislava, Slovakia. ²¹¹Coimbra Institute for Clinical and Biomedical Research (iCIBR), Faculty of Medicine, University of Coimbra, Portugal; Ageing@Coimbra EIP-AHA Reference Site, Coimbra, Portugal. ²¹²Medical center Iskar Ltd Sofia, Bulgaria. ²¹³Department of Medicine (RCSI), Bon Secours Hospital, Glasnevin, Dublin, Ireland. ²¹⁴Kronikgune, International Centre of Excellence in Chronicity Research Barakaldo, Bizkaia, Spain. ²¹⁵Division of Clinical Immunology and Allergy, Laboratory of Behavioral Immunology Research, The University of Mississippi Medical Center, Jackson, Mississippi, USA. ²¹⁶Tobacco Control Research Centre; Iranian Anti Tobacco Association, Tehran, Iran. ²¹⁷Argentine Association of Allergy and Clinical Immunology, Buenos Aires, Argentina. ²¹⁸Mexico City, Mexico. ²¹⁹University of Southeast Bahia, Brazil. ²²⁰Allergie-Centrum-Charité at the Department of Dermatology and Allergy, Charité - Universitätsmedizin Berlin, Germany. ²²¹Maputo Central Hospital—Department of Paediatrics, Mozambique. ²²²Veracruz, Mexico. ²²³Sachs' Children and Youth Hospital, Södersjukhuset, Stockholm and Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden. ²²⁴Allergy and Asthma Medical Group and Research Center, San Diego, California, USA. ²²⁵CIRFF, Federico II University, Naples, Italy. ²²⁶Department of Physiology, CHRU, University Montpellier, Vice President for Research, PhyMedExp, INSERM U1046, CNRS UMR 9214, France. ²²⁷Croatian Pulmonary Society. ²²⁸National Institute of Pneumology M Nasta, Bucharest, Romania. ²²⁹Clinic for Pulmonary Diseases, Clinical Center of Serbia, Faculty of Medicine, University of Belgrade, Serbian Association for Asthma and COPD, Belgrade, Serbia. ²³⁰Regione Piemonte, Torino, Italy. ²³¹Col Jardines de Sta Monica, Tlalneapantla, Mexico. ²³²National Center for Research in Chronic Respiratory Diseases, Tishreen University School of Medicine, Latakia, Syria. ²³³Department of Public health and health products, Paris Descartes University-Sorbonne Paris Cité, EA 4064 and Paris Municipal Department of social action, childhood, and health, Paris, France. ²³⁴Paris municipal Department of social action, childhood, and health, Paris, France. ²³⁵Lead Respiratory Physician Mater Dei Hospital Malta, Academic Head of Dept and Professor of Medicine University of Malta, Deputy Dean Faculty of Medicine and Surgery University of Medicine, La Valette, Malta. ²³⁶Department of Medical Sciences, Allergy and Clinical Immunology Unit, University of Torino & Mauriziano Hospital, Torino, Italy. ²³⁷Instituto de Prevision Social IPS HC, Socia de la SPAAI, Tesorera de la SLAAI, Asuncion, Paraguay. ²³⁸Allergy Center, CUF Descobertas Hospital, Lisbon, Portugal. ²³⁹Universidade de São Paulo, São Paulo, Brazil. ²⁴⁰Institute of Medical Statistics, and Computational Biology, Medical Faculty, University of Cologne, Germany and CRI-Clinical Research International-Ltd, Hamburg, Germany. ²⁴¹General Pathology Institute, Faculty of Medicine, University of Coimbra, Portugal; Ageing@Coimbra EIP-AHA Reference Site, Coimbra, Portugal. ²⁴²Federal University of Bahia, Brazil. ²⁴³Rhinology Unit & Smell Clinic, ENT Department, Hospital Clinic; Clinical & Experimental Respiratory Immunoallergy, IDIBAPS, CIBERES, University of Barcelona, Spain. ²⁴⁴Danish Committee for Health Education, Copenhagen East, Denmark. ²⁴⁵Food Allergy Referral Centre Veneto Region, Department of Women and Child Health, Padua General University Hospital, Padua, Italy. ²⁴⁶Director, Medical Communications Consultant, MedScript Ltd, Dundalk, Co Louth, Ireland and Honorary Research Fellow, OPC, Cambridge, UK Ireland. ²⁴⁷Johns Hopkins School of Medicine, Baltimore, Maryland, USA. ²⁴⁸General Manager of COFASER - Pharmacy Services Consortium, Salerno, Italy. ²⁴⁹Scientific Centre of Children's Health under the MoH, Moscow, Russian National Research Medical University named Pirogov, Moscow, Russia. ²⁵⁰Director of Center of Allergy, Immunology and Respiratory Diseases, Santa Fe, Argentina Center for Allergy and Immunology, Santa Fe, Argentina. ²⁵¹Dept of Otorhinolaryngology, Medical University of Vienna, AKH, Vienna, Austria. ²⁵²Hospital of the Hospitaller Brothers in Buda, Budapest, Hungary. ²⁵³Die Hautambulanz und Rothhaar study center, Berlin, Germany. ²⁵⁴Neumologia y Alergología Infantil, Hospital La Fe, Valencia, Spain. ²⁵⁵Center for Health Technology and Services Research - CINTESIS and Department of Internal Medicine, Centro Hospitalar Sao Joao, Porto, Portugal. ²⁵⁶Caisse d'assurance retraite et de la santé au travail du Languedoc-Roussillon (CARSAT-LR), Montpellier, France. ²⁵⁷Director of Department of Pharmacy of University of Naples Federico II, Naples, Italy. ²⁵⁸ENT Department, University Hospital of Kinshasa, Kinshasa, Congo. ²⁵⁹Department of Allergy, Immunology and Respiratory Medicine, Alfred Hospital and Central Clinical School, Monash University, Melbourne, Victoria, Australia; Department of Immunology, Monash University, Melbourne, Victoria, Australia. ²⁶⁰Medical center "Research expert", Varna, Bulgaria. ²⁶¹National Hospital Organization, Tokyo National Hospital, Tokyo, Japan. ²⁶²Dept of Otorhinolaryngology, Chiba University Hospital, Chiba, Japan. ²⁶³Dept of Otolaryngology, Nippon Medical School, Tokyo, Japan. ²⁶⁴Jalisco, Guadalajara. ²⁶⁵Centre Hospitalier Universitaire Pédiatrique Charles de Gaulle, Ouagadougou, Burkina Faso. ²⁶⁶Dept of Comparative

Medicine; Messerli Research Institute of the University of Veterinary Medicine and Medical University, Vienna, Austria.²⁶⁷Department of Immunology and Allergology, Faculty of Medicine and Faculty Hospital in Pilsen, Charles University in Prague, Pilsen, Czech Republic.²⁶⁸Division of Infection, Immunity & Respiratory Medicine, Royal Manchester Children's Hospital, University of Manchester, Manchester, UK, and Allergy Department, 2nd Pediatric Clinic, Athens General Children's Hospital "P&A Kyriakou," University of Athens, Athens, Greece.²⁶⁹Department of Allergy and Clinical Immunology, Ajou University School of Medicine, Suwon, South Korea.²⁷⁰Respiratory Medicine, Department of Medical Sciences, University of Ferrara, Ferrara, Italy.²⁷¹Allergy and Respiratory Diseases, Ospedale Policlinico San Martino -University of Genoa, Italy.²⁷²Farmacias Holon, Lisbon, Portugal.²⁷³Department of Pediatrics, Nippon Medical School, Tokyo, Japan.²⁷⁴University of Southern Denmark, Kolding, Denmark.²⁷⁵Université Grenoble Alpes, Laboratoire HP2, Grenoble, INSERM, U1042 and CHU de Grenoble, France.²⁷⁶Allergy Unit, CUF-Porto Hospital and Institute; Center for Research in Health Technologies and information systems CINTESIS, Universidade do Porto, Portugal.²⁷⁷Sociologist, municipality area n33, Sorrento, Italy.²⁷⁸Center for Rhinology and Allergology, Wiesbaden, Germany.²⁷⁹Department of Otorhinolaryngology, Head and Neck Surgery, Universitätsmedizin Mannheim, Medical Faculty Mannheim, Heidelberg University, Mannheim, Germany.²⁸⁰Centre for empowering people and communities, Dublin, UK.²⁸¹Conseil Général de l'Economie Ministère de l'Economie, de l'Industrie et du Numérique, Paris, France.²⁸²Société de Pneumologie de Langue Française, Espace francophone de Pneumologie, Paris, France.²⁸³Département de pédiatrie, CHU de Grenoble, Grenoble France.²⁸⁴Medical School, University of Cyprus, Nicosia, Cyprus.²⁸⁵Children's Hospital Srebrnjak, Zagreb, School of Medicine, University J.J. Strossmayer, Osijek, Croatia.²⁸⁶Karl Landsteiner Institute for Clinical and Experimental Pneumology, Hietzing Hospital, Vienna, Austria.²⁸⁷University Hospital "Sv. Ivan Rilski", Sofia, Bulgaria.²⁸⁸Allergy Diagnostic and Clinical Research Unit, University of Cape Town Lung Institute, Cape Town, South Africa.²⁸⁹Vice-Presidente of IML, Milano, Italy.²⁹⁰Centre of Academic Primary Care, Division of Applied Health Sciences, University of Aberdeen, Aberdeen, United Kingdom ; Observational and Pragmatic Research Institute, Singapore, Singapore.²⁹¹Department of Otorhinolaryngology University of Crete School of Medicine, Heraklion, Greece.²⁹²European Forum for Research and Education in Allergy and Airway Diseases (EUFORA), Brussels, Belgium.²⁹³Cancun, Quintana Roo, Mexico.²⁹⁴LungenClinic Grosshansdorf, Airway Research Center North, Member of the German Center for Lung Research (DZL), Grosshansdorf, Germany Department of Medicine, Christian Albrechts University, Airway Research Center North, Member of the German Center for Lung Research (DZL), Kiel, Germany.²⁹⁵Department of Nephrology and Endocrinology, Karolinska University Hospital, Stockholm, Sweden.²⁹⁶Farmácia São Paio, Vila Nova de Gaia, Porto, Portugal.²⁹⁷St Vincent's Hospital and University of Sydney, Sydney, New South Wales, Australia.²⁹⁸Puebla, Mexico.²⁹⁹Serviço de Pneumologia-Hosp das Clinicas UFPE-EBSERH, Recife, Brazil.³⁰⁰Universidade Federal de São Paulo, São Paulo, Brazil.³⁰¹Centre of Pneumology, Coimbra University Hospital, Portugal.³⁰²Polibienestar Research Institute, University of Valencia, Valencia, Spain.³⁰³Pediatric Allergy and Clinical Immunology, Hospital Angeles Pedregal, Mexico City, Mexico.³⁰⁴Getafe University Hospital Department of Geriatrics, Madrid, Spain.³⁰⁵Association Asthme et Allergie, Paris, France.³⁰⁶Universidade Federal do Rio de Janeiro, Rio de Janeiro, Brazil.³⁰⁷Primary Care Respiratory Research Unit Instituto de Investigación Sanitaria de Palma IdisPa, Palma de Mallorca, Spain.³⁰⁸Allergy Unit, Presidio Columbus, Rome, Catholic University of Sacred Heart, Rome and IRCCS Oasi Maria SS, Troina, Italy.³⁰⁹Mexico City, Mexico.³¹⁰Regione Piemonte, Torino, Italy.³¹¹Medical University of Graz, Department of Internal Medicine, Graz, Austria.³¹²Serviço de Imunoalergologia Hospital da Luz Lisboa Portugal.³¹³Hospital de Clinicas, University of Parana, Brazil.³¹⁴Division of Allergy Asthma and Clinical Immunology, Emek Medical Center, Afula, Israel.³¹⁵Honorary Clinical Research Fellow, Allergy and Respiratory Research Group, The University of Edinburgh, Edinburgh, UK.³¹⁶Showa University School of Medicine, Tokyo, Japan.³¹⁷Association of Finnish Pharmacies.³¹⁸Allergy and Clinical Immunology Department, Centro Médico-Docente la Trinidad and Clínica El Ávila, Caracas, Venezuela.³¹⁹Faculty of Medicine, Autonous University of Madrid, Spain.³²⁰The Royal National TNE Hospital, University College London, UK.³²¹DIBIMIS, University of Palermo, Italy.³²²Allergy Unit, Department of Dermatology, University Hospital of Zurich, Zürich, Switzerland.³²³Asthma Reference Center, Escola Superior de Ciências da Santa Casa de Misericórdia de Vitória - Esperito Santo, Brazil.³²⁴The Usher Institute of Population Health Sciences and Informatics, The University of Edinburgh, Edinburgh, UK.³²⁵Department of Pediatrics & Child Health, Department of Immunology, Faculty of Medicine, University of Manitoba, Winnipeg, Manitoba, Canada.³²⁶INSERM, Université Grenoble Alpes, IAB, U 1209, Team of Environmental Epidemiology applied to Reproduction and Respiratory Health, Université Joseph Fourier, Grenoble, France.³²⁷Sociedad Paraguaya de Alergia Asma e Inmunología, Paraguay.³²⁸Division of Allergy, Clinical Immunology and Rheumatology, Department of Pediatrics, Federal University of São Paulo, São Paulo, Brazil.³²⁹European Health Futures Forum (EHFF), Dromahair, Ireland.³³⁰ENT, Aachen, Germany.³³¹Kyrgyzstan National Centre of Cardiology and Internal medicine, Euro-Asian respiratory Society, Bishkek, Kyrgyzstan.³³²University Hospital Olomouc, Czech Republic.³³³Department of Paediatric and Adolescent medicine, University Hospital of North Norway, Tromsø, Paediatric Research Group, Department of Clinical Medicine, Faculty of Health Sciences, UiT The Arctic University of Norway, Tromsø, Norway.³³⁴Presidente, IML (Lombardy Medical Initiative), Bergamo, Italy.³³⁵Pulmonary Division, Heart Institute (InCor), Hospital da Clinicas da Faculdade de Medicina da Universidade de São Paulo, São Paulo, Brazil.³³⁶Public Health Institute of Vilnius University, Vilnius, Lithuania.³³⁷Universidade Federal do Estado do Rio de Janeiro, Rio de Janeiro - Brazil.³³⁸RNSA (Réseau National de Surveillance Aérobiologique), Brüssel, France.³³⁹The Hospital for Sick Children, Dalla Lana School of Public Health, University of Toronto, Canada.³⁴⁰Imunoalergologia, Centro Hospitalar Universitário de Coimbra and Faculty of Medicine, University of Coimbra, Portugal.³⁴¹Department of ENT, Medical University of Graz, Austria.³⁴²Campania Region, Division on Pharmacy and devices policy, Naples, Italy.³⁴³Department of Respiratory Medicine, Hvidovre Hospital & University of Copenhagen, Denmark.³⁴⁴Universidade Federal dos Pampas, Uruguaiana, Brazil.³⁴⁵Division of Immunopathology, Department of Pathophysiology and Allergy Research, Center for Pathophysiology, Infectiology and Immunology, Medical University of Vienna, Vienna, Austria.³⁴⁶Pneumology and Allergy Department CIBERES and Clinical & Experimental Respiratory Immunoallergy, IDIBAPS, University of Barcelona, Spain.³⁴⁷Vilnius University Institute of Clinical Medicine, Clinic of Children's Diseases, and Institute of Health Sciences, Department of Public Health, Vilnius, Lithuania; European Academy of Paediatrics (EAP/UEMS-SP), Brussels, Belgium.³⁴⁸Department of Lung Diseases and Clinical Immunology Allergology, University of Turku and Terveystalo allergy clinic, Turku, Finland.³⁴⁹PELyon; HESPER 7425, Health Services and Performance Research - Université Claude Bernard Lyon, France.³⁵⁰Immunology and Allergy Unit, Department of Medicine Solna, Karolinska Institutet and University Hospital, Stockholm.³⁵¹Department of Chest Medicine, Centre Hospitalier Universitaire UCL Namur, Université Catholique de Louvain, Yvoir, Belgium.³⁵²University of Bari Medical School, Unit of Geriatric Immunoallergology, Bari, Italy.³⁵³Pulmonary Unit, Department of Medical Specialties, Arcispedale S.Maria Nuova/IRCCS, AUSL di Reggio Emilia, Italy.³⁵⁴FILHA, Finnish Lung Association, Helsinki, Finland.³⁵⁵Pulmonary Environmental Epidemiology Unit, CNR Institute of Clinical Physiology, Pisa, Italy ; and CNR Institute of Biomedicine and Molecular Immunology "A Monroy", Palermo, Italy.³⁵⁶Medical University, Plovdiv, Bulgaria, Department of Otorhinolaryngology, Plovdiv, Bulgaria.³⁵⁷Sotiria Hospital, Athens, Greece.³⁵⁸Dept of Otorhinolaryngology, Universitätsklinikum Düsseldorf, Germany.³⁵⁹Asthma UK, Mansell street, London, UK.³⁶⁰Nova Southeastern University, Fort Lauderdale, Florida, USA.³⁶¹Department of Otolaryngology, Yong Loo Lin School of Medicine, National University of Singapore, Singapore, Singapore.³⁶²Department of Medicine, Clinical Immunology and Allergy, McMaster University, Hamilton, Ontario, Canada.³⁶³Division of Immunodermatology and Allergy Research, Department of Dermatology and Allergy, Hannover Medical School, Hannover, Germany.³⁶⁴Department of Medicine Solna, Immunology and Allergy Unit, Karolinska Institutet and Department of ENT diseases, Karolinska University Hospital, Stockholm, Sweden.³⁶⁵Eshelman School of Pharmacy, University of North Carolina, Chapel Hill, NC, USA.³⁶⁶International Primary Care Respiratory Group IPCRG, Aberdeen, Scotland.³⁶⁷Bradford Institute for Health Research, Bradford Royal Infirmary, Bradford, UK.³⁶⁸Allergologist - Medical College of Medical Faculty, Thracian University, Stara Zagora, Bulgaria.³⁶⁹Department of Research, Olmsted Medical Center, Rochester, Minnesota, USA.³⁷⁰Cyprus International Institute for Environmental & Public Health in Association with Harvard School of Public Health, Cyprus University of Technology, Limassol, Cyprus; Department of Pediatrics, Hospital "Archbishop Makarios III", Nicosia, Cyprus.³⁷¹Celal Bayar University Department of Pulmonology, Manisa, Turkey.³⁷²The Allergy and Asthma Institute, Pakistan.³⁷³Department of Paediatrics and Child Health, Red Cross Children's Hospital, and MRC Unit on Child & Adolescent Health, University of Cape Town, Cape Town, South Africa.³⁷⁴Department of Otolaryngology Head and Neck Surgery, Beijing TongRen Hospital and Beijing

Institute of Otolaryngology, Beijing, China. ³⁷⁵Universidad Católica de Córdoba, Córdoba, Argentina. ³⁷⁶University Clinic of Respiratory and Allergic Diseases, Golnik, Slovenia. ³⁷⁷Gesundheitsregion KölnBonn - HRCB Projekt GmbH, Kohn, Germany. ³⁷⁸Akershus University Hospital, Department of Otorhinolaryngology, Akershus, Norway.

Competing interests

SBA reports personal fees from Boehringer Ingelheim, GSK, AstraZeneca, TEVA, grants from TEVA, MEDA outside the submitted work. JB reports personal fees and other from Chiesi, Cipla, Hikma, Menarini, Mundipharma, Mylan, Novartis, Sanofi-Aventis, Takeda, Teva, Uriach, other from Kyomed, outside the submitted work. AAC reports grants and personal fees from GlaxoSmithKline, personal fees from Boehringer Ingelheim, personal fees from AstraZeneca, personal fees from Novartis, personal fees from Merk, Sharp & Dohma, personal fees from MEDA Pharma, personal fees from EUROFARMA, personal fees from Sanofi Aventis, outside the submitted work. MD reports other from Allergan, outside the submitted work. WF reports grants from Meda, outside the submitted work. TH reports personal fees from Mundipharma, Novartis, and Orion Pharma, outside the submitted work. JJ reports grants and personal fees from novartis, ALK abello, personal fees from thermofischer, astra zeneca outside the submitted work. PK reports personal fees from Adamed, Boehringer Ingelheim, AstraZeneca, Chiesi, FAES, Berlin Chemie, Novartis, Polpharma, Allergopharma, outside the submitted work. VK has received payment for consultancy from GSK and for lectures from Stallergens, Berlin-Chemie outside the submitted work. DLL reports personal fees from GSK, Astrazeneca, MEDA, Boehringer Ingelheim, Novartis, Grunenthal, UCB, Armstrong, Siegfried, DBV Technologies, MSD, Pfizer, grants from Sanofi, Astrazeneca, Novartis, UCB, GSK, TEVA, Chiesi, Boehringer Ingelheim, outside the submitted work. RM reports personal fees from ALK, grants from ASIT biotech, Leti, BitopAG, Hulka, Ursapharm, Optima; personal fees from allergopharma, Nuvo, Meda, Friulchem, Hexal, Servier, Bayer, Johnson&Johnson, Klosterfrau, GSK, MSD, FAES, Stada, UCB, Allergy Therapeutics; grants and personal fees from Bencard, Stallergenes; grants, personal fees and non-financial support from Lofarma; non-financial support from Roxall, Atmos, Bionorica, Otonomy, Ferrero; personal fees and non-financial support from Novartis. NP reports personal fees from Novartis, Faes Farma, BIOMAY, HAL, Nutricia Research, Menarini, Novartis, MEDA, Abbvie, MSD, Omega Pharma, Danone, grants from Menarini, outside the submitted work. JLP reports grants from Air Liquide Foundation, AGIR à dom, Astrazeneca, Fisher & Paykel, Mutualia, Philips, Resmed, Vitalaire, other from AGIR à dom, Astrazeneca, Boehringer Ingelheim, Jazz Pharmaceutical, Night Balance, Philips, Resmed, Sefam, outside the submitted work. OP reports grants and personal fees from ALK-Abelló, Allergopharma, Stallergenes Greer, HAL Allergy Holding B.V./HAL Allergie GmbH, Bencard Allergie GmbH/Allergy Therapeutics, Lofarma, Biotech Tools S.A., Laboratorios LETI/LETI Pharma, Anergis S.A., grants from Biomay, Nuvo, Circassia, Glaxo Smith Kline, personal fees from Novartis Pharma, MEDA Pharma, Mobile Chamber Experts (a GA²LEN Partner), Pohl-Boskamp, Indoor Biotechnologies, grants from, outside the submitted work. AMTB reports grants and personal fees from Novartis, Boehringer Ingelheim, Mundipharma, GSK (GlaxoSmithKline), personal fees from Teva Pharma, AstraZeneca, grants from Leti, outside the submitted work. SW reports personal fees from Merck, GSK, Novartis, Behring, Shire, Sanofi, Barid Aralez, Mylan Meda, Padiapharm outside the submitted work.

Availability of data and materials

Not applicable.

Ethics approval and consent to participate

Not applicable.

Funding

FMC VIA LR.

Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Received: 31 July 2018 Accepted: 7 September 2018

Published online: 25 October 2018

References

- Bousquet J, Khaltaev N, Cruz AA, Denburg J, Fokkens WJ, Togias A, et al. Allergic rhinitis and its impact on asthma (ARIA) 2008 update (in collaboration with the World Health Organization, GA(2)LEN and AllerGen). *Allergy*. 2008;63(Suppl 86):8–160.
- Vandenplas O, Vinnikov D, Blanc PD, Agache I, Bachert C, Bewick M, et al. Impact of rhinitis on work productivity: a systematic review. *J Allergy Clin Immunol Pract*. 2018;6(4):1274–86.
- Bousquet J, Bachert C, Canonica GW, Casale TB, Cruz AA, Lockey RJ, et al. Unmet needs in severe chronic upper airway disease (SCUAD). *J Allergy Clin Immunol*. 2009;124(3):428–33.
- Bousquet J, Mantzouranis E, Cruz AA, Ait-Khaled N, Baena-Cagnani CE, Bleecker ER, et al. Uniform definition of asthma severity, control, and exacerbations: document presented for the World Health Organization Consultation on Severe Asthma. *J Allergy Clin Immunol*. 2010;126(5):926–38.
- De Greve G, Hellings PW, Fokkens WJ, Pugin B, Steelant B, Seys SF. Endotype-driven treatment in chronic upper airway diseases. *Clin Transl Allergy*. 2017;7:22.
- Cingi C, Gevaert P, Mosges R, Rondon C, Hox V, Rudenko M, et al. Multimorbidities of allergic rhinitis in adults: European Academy of Allergy and Clinical Immunology task force report. *Clin Transl Allergy*. 2017;7:17.
- Frohlich M, Pinart M, Keller T, Reich A, Cabieses B, Hohmann C, et al. Is there a sex-shift in prevalence of allergic rhinitis and comorbid asthma from childhood to adulthood? A meta-analysis. *Clin Transl Allergy*. 2017;7:44.
- Bousquet J, Addis A, Adcock I, Agache I, Agustí A, Alonso A, et al. Integrated care pathways for airway diseases (AIRWAYS-ICPs). *Eur Respir J*. 2014;44(2):304–23.
- Hellings PW, Fokkens WJ, Bachert C, Akdis CA, Bieber T, Agache I, et al. Positioning the principles of precision medicine in care pathways for allergic rhinitis and chronic rhinosinusitis—an EUFOREA-ARIA-EPOS-AIRWAYS ICP statement. *Allergy*. 2017;72(9):1297–305.
- Bousquet J, Schunemann HJ, Fonseca J, Samolinski B, Bachert C, Canonica GW, et al. MACVIA-ARIA Sentinel Network for allergic rhinitis (MASK-rhinitis): the new generation guideline implementation. *Allergy*. 2015;70(11):1372–92.
- Hellings PW, Fokkens WJ, Akdis C, Bachert C, Cingi C, Dietz de Loos D, et al. Uncontrolled allergic rhinitis and chronic rhinosinusitis: where do we stand today? *Allergy*. 2013;68(1):1–7.
- mHealth. New horizons for health through mobile technologies. Global Observatory for eHealth series—Vol. 3 WHO Library Cataloguing-in-Publication Data. 2011; http://www.who.int/goe/publications/goe_mhealth_web.pdf. Accessed 30 Sept 2018.
- Ozdalga E, Ozdalga A, Ahuja N. The smartphone in medicine: a review of current and potential use among physicians and students. *J Med Internet Res*. 2012;14(5):e128.
- Freifeld CC, Chunara R, Mekaru SR, Chan EH, Kass-Hout T, Ayala Iacucci A, et al. Participatory epidemiology: use of mobile phones for community-based health reporting. *PLoS Med*. 2010;7(12):e1000376.
- Keijser W, de-Manuel-Keenoy E, d'Angelantonio M, Stafylas P, Hobson P, Apuzzo G, et al. DG Connect funded projects on information and communication technologies (ICT) for old age people: Beyond Silos, CareWell and SmartCare. *J Nutr Health Aging*. 2016;20(10):1024–33.
- Mozaffar H, Cresswell KM, Williams R, Bates DW, Sheikh A. Exploring the roots of unintended safety threats associated with the introduction of hospital ePrescribing systems and candidate avoidance and/or mitigation strategies: a qualitative study. *BMJ Qual Saf*. 2017;26(9):722–733.
- Talboom-Kamp EP, Verdijk NA, Harmans LM, Numans ME, Chavannes NH. An eHealth platform to manage chronic disease in primary care: an innovative approach. *Interact J Med Res*. 2016;5(1):e5.
- Lee L, Sheikh A. Understanding stakeholder interests and perspectives in evaluations of health IT. *Stud Health Technol Inf*. 2016;222:53–62.
- Geryk LL, Roberts CA, Sage AJ, Coyne-Beasley T, Sleath BL, Carpenter DM. Parent and clinician preferences for an asthma app to promote adolescent self-management: a formative study. *JMIR Res Protoc*. 2016;5(4):e229.
- Bousquet J, Chavannes NH, Guldemond N, Haastela T, Hellings PW, Sheikh A. Realising the potential of mHealth to improve asthma and allergy care: how to shape the future. *Eur Respir J*. 2017;49(5):1700447.

21. Lau AY, Arguel A, Dennis S, Liaw ST, Coiera E. "Why Didn't it Work?" Lessons from a randomized controlled trial of a web-based personally controlled health management system for adults with asthma. *J Med Internet Res*. 2015;17(12):e283.
22. Simpson AJ, Honkoop PJ, Kennington E, Snoeck-Stroband JB, Smith I, East J, et al. Perspectives of patients and healthcare professionals on mHealth for asthma self-management. *Eur Respir J*. 2017. <https://doi.org/10.1183/13993003.01966-2016>.
23. Bousquet J, Van Cauwenberge P, Khaltaev N. Allergic rhinitis and its impact on asthma. *J Allergy Clin Immunol*. 2001;108(5 Suppl):S147–334.
24. Brozek JL, Bousquet J, Baena-Cagnani CE, Bonini S, Canonica GW, Casale TB, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines: 2010 revision. *J Allergy Clin Immunol*. 2010;126(3):466–76.
25. Brozek JL, Bousquet J, Agache I, Agarwal A, Bachert C, Bosnic-Anticevich S, et al. Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines—2016 revision. *J Allergy Clin Immunol*. 2017;140(4):950–8.
26. Bousquet J, Hellings PW, Agache I, Bedbrook A, Bachert C, Bergmann KC, et al. ARIA 2016: care pathways implementing emerging technologies for predictive medicine in rhinitis and asthma across the life cycle. *Clin Transl Allergy*. 2016;6:47.
27. Lombardi C, Musico E, Rastrelli F, Bettoncelli G, Passalacqua G, Canonica GW. The patient with rhinitis in the pharmacy. A cross-sectional study in real life. *Asthma Res Pract*. 2015;1:4.
28. Bousquet J, Schunemann HJ, Hellings PW, Arnauvelhe S, Bachert C, Bedbrook A, et al. MACVIA clinical decision algorithm in adolescents and adults with allergic rhinitis. *J Allergy Clin Immunol*. 2016;138(2):367–74 (e2).
29. Bourret R, Bousquet J, Mercier J, Camuzat T, Bedbrook A, Demoly P, et al. MASK rhinitis, a single tool for integrated care pathways in allergic rhinitis. *World Hosp Health Serv*. 2015;51(3):36–9.
30. Hellings PW, Muraro A, Fokkens W, Mullol J, Bachert C, Canonica GW, et al. A common language to assess allergic rhinitis control: results from a survey conducted during EAACI 2013 Congress. *Clin Transl Allergy*. 2015;5:36.
31. Klimek L, Bergmann KC, Biedermann T, Bousquet J, Hellings P, Jung K, et al. Visual analogue scales (VAS): measuring instruments for the documentation of symptoms and therapy monitoring in cases of allergic rhinitis in everyday health care: position Paper of the German Society of Allergology (AeDA) and the German Society of Allergy and Clinical Immunology (DGAKI), ENT Section, in collaboration with the working group on Clinical Immunology, Allergy and Environmental Medicine of the German Society of Otorhinolaryngology, Head and Neck Surgery (DGHNOKHC). *Allergo J Int*. 2017;26(1):16–24.
32. Bousquet J, Farrell J, Crooks G, Hellings P, Bel EH, Bewick M, et al. Scaling up strategies of the chronic respiratory disease programme of the European Innovation Partnership on Active and Healthy Ageing (Action Plan B3: Area 5). *Clin Transl Allergy*. 2016;6:29.
33. Bousquet J, Caimmi DP, Bedbrook A, Bewick M, Hellings PW, Devillier P, et al. Pilot study of mobile phone technology in allergic rhinitis in European countries: the MASK-rhinitis study. *Allergy*. 2017;72(6):857–65.
34. Bousquet J, Bewick M, Arnauvelhe S, Mathieu-Dupas E, Murray R, Bedbrook A, et al. Work productivity in rhinitis using cell phones: the MASK pilot study. *Allergy*. 2017;72(10):1475–84.
35. Aristodimou A, Antoniadou A, Pattichis CS. Privacy preserving data publishing of categorical data through k-anonymity and feature selection. *Healthc Technol Lett*. 2016;3(1):16–21.
36. Aldeen YA, Salleh M, Razzaque MA. A comprehensive review on privacy preserving data mining. Springerplus. 2015;4:694.
37. Protection of personal data. Article 29 data protection working party. Opinion 05/2014 on anonymisation techniques. European Commission Justice Data Protection. 2014;0829/14/EN WP216. http://ec.europa.eu/justice/data-protection/index_en.htm. Accessed 30 Sept 2018.
38. Regulation (EU) 2016/679 of the European Parliament and of the Council of 27 April 2016 on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation). Official Organ of the European Union. 2016. <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016R0679&from=EN>. Accessed 30 Sept 2018.
39. Article 28 EU General Data Protection Regulation (EU-GDPR). 2018. <https://www.eugdpr.org/>. Accessed 30 Sept 2018.
40. Directive 2002/58/EC of the European Parliament and of the Council of 12 July 2002 concerning the processing of personal data and the protection of privacy in the electronic communications sector (Directive on privacy and electronic communications). *Off J Eur Commun L*. 201, 37; 31 July 2002.
41. Directive 2009/136/EC of The European Parliament and of the Council of 25 November 2009 amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services, Directive 2002/58/EC concerning the processing of personal data and the protection of privacy in the electronic communications sector and Regulation (EC) No 2006/2004 on cooperation between national authorities responsible for the enforcement of consumer protection laws. *Off J Eur Union, L* 337, 11; 18 December 2009.
42. Sweeney L. k-anonymity: a model for protecting privacy. *Int J Uncertain Fuz Knowl Syst*. 2002;10:557–70.
43. El Emam K, Dankar FK, Issa R, et al. A globally optimal k-anonymity method for the de-identification of health data. *J Am Med Inform Assoc*. 2009;16:670–82.
44. Samreth D, Arnauvelhe S, Ingenrieth F, Bedbrook A, Onorato GL, Murray R, et al. Geolocation with respect to personal privacy for the Allergy Diary app—a MASK study. *World Allergy Organ J*. 2018;11(1):15. <https://doi.org/10.1186/s40413-018-0194-3>.
45. Bland JM, Altman DG. Statistical methods for assessing agreement between two methods of clinical measurement. *Lancet*. 1986;1(8476):307–10.
46. Bousquet J, Agache I, Aliberti MR, Angles R, Annesi-Maesano I, Anto JM, et al. Transfer of innovation on allergic rhinitis and asthma multimorbidity in the elderly (MACVIA-ARIA)—EIP on AHA Twinning Reference Site (GARD research demonstration project). *Allergy*. 2018;73(1):77–92.
47. König HH, Bernert S, Angermeyer MC, Matschinger H, Martinez M, Vilagut G, et al. Comparison of population health status in six European countries: results of a representative survey using the EQ-5D questionnaire. *Med Care*. 2009;47(2):255–61.
48. Smith AF, Pitt AD, Rodriguez AE, Alio JL, Marti N, Teus M, et al. The economic and quality of life impact of seasonal allergic conjunctivitis in a Spanish setting. *Ophthalmic Epidemiol*. 2005;12(4):233–42.
49. Bousquet J, VandenPlas O, Bewick M, Arnauvelhe S, Bedbrook A, Murray R, et al. The Work Productivity and Activity Impairment Allergic Specific (WPAI-AS) Questionnaire using mobile technology: the MASK study. *J Investig Allergol Clin Immunol*. 2018;28(1):42–4.
50. Azevedo P, Correia de Sousa J, Bousquet J, Bugalho-Almeida A, Del Giacco SR, Demoly P, et al. Control of Allergic Rhinitis and Asthma Test (CARAT): dissemination and applications in primary care. *Prim Care Respir J*. 2013;22(1):112–6.
51. Fonseca JA, Nogueira-Silva L, Morais-Almeida M, Azevedo L, Sa-Sousa A, Branco-Ferreira M, et al. Validation of a questionnaire (CARAT10) to assess rhinitis and asthma in patients with asthma. *Allergy*. 2010;65(8):1042–8.
52. Nogueira-Silva L, Martins SV, Cruz-Correia R, Azevedo LF, Morais-Almeida M, Bugalho-Almeida A, et al. Control of allergic rhinitis and asthma test—a formal approach to the development of a measuring tool. *Respir Res*. 2009;10:52.
53. van der Leeuw S, van der Molen T, Dekhuijzen PN, Fonseca JA, van Gemert FA, Gerth van Wijk R, et al. The minimal clinically important difference of the control of allergic rhinitis and asthma test (CARAT): cross-cultural validation and relation with pollen counts. *NPJ Prim Care Respir Med*. 2015;25:14107.
54. Johns MW. Reliability and factor analysis of the Epworth Sleepiness Scale. *Sleep*. 1992;15(4):376–81.
55. Leger D, Annesi-Maesano I, Carat F, Rugina M, Chanal I, Pribil C, et al. Allergic rhinitis and its consequences on quality of sleep: an unexplored area. *Arch Intern Med*. 2006;166(16):1744–8.
56. Kopp-Kubel S. International Nonproprietary Names (INN) for pharmaceutical substances. *Bull World Health Organ*. 1995;73(3):275–9.
57. Santo K, Richtering SS, Chalmers J, Thiagalingam A, Chow CK, Redfern J. Mobile phone apps to improve medication adherence: a systematic stepwise process to identify high-quality apps. *JMIR Mhealth Uhealth*. 2016;4(4):e132.
58. Thakkar J, Kurup R, Laba TL, Santo K, Thiagalingam A, Rodgers A, et al. Mobile telephone text messaging for medication adherence in chronic disease: a meta-analysis. *JAMA Intern Med*. 2016;176(3):340–9.

59. Bousquet J, Arnavielhe S, Bedbrook A, Alexis-Alexandre G, van Eerd M, Murray R, et al. Treatment of allergic rhinitis using mobile technology with real world data: the MASK observational pilot study. *Allergy*. 2018;73(9):1763–74.
60. Devillier P, Chassany O, Vicaud E, de Beaumont O, Robin B, Dreyfus JF, et al. The minimally important difference in the Rhinoconjunctivitis Total Symptom Score in grass-pollen-induced allergic rhinoconjunctivitis. *Allergy*. 2014;69(12):1689–95.
61. Onder G, Palmer K, Navickas R, Jureviciene E, Mammarella F, Strandzheva M, et al. Time to face the challenge of multimorbidity. A European perspective from the joint action on chronic diseases and promoting healthy ageing across the life cycle (JA-CHRODIS). *Eur J Intern Med*. 2015;26(3):157–9.
62. Bousquet J, Onorato GL, Bachert C, Barbolini M, Bedbrook A, Bjermer L, et al. CHRODIS criteria applied to the MASK (MACVIA-ARIA Sentinel Network) Good Practice in allergic rhinitis: a SUNFRAIL report. *Clin Transl Allergy*. 2017;7:37.
63. Mokkink LB, Terwee CB, Patrick DL, Alonso J, Stratford PW, Knol DL, et al. The COSMIN study reached international consensus on taxonomy, terminology, and definitions of measurement properties for health-related patient-reported outcomes. *J Clin Epidemiol*. 2010;63(7):737–45.
64. Caimmi D, Baiz N, Tanno LK, Demoly P, Arnavielhe S, Murray R, et al. Validation of the MASK-rhinitis visual analogue scale on smartphone screens to assess allergic rhinitis control. *Clin Exp Allergy*. 2017;47(12):1526–33.
65. Bousquet J, Devillier P, Anto JM, Bewick M, Haahtela T, Arnavielhe S, et al. Daily allergic multimorbidity in rhinitis using mobile technology: a novel concept of the MASK study. *Allergy*. 2018;73(8):1622–31.
66. Tan R, Cvetkovski B, Kritikos V, Price D, Yan K, Smith P, et al. Identifying the hidden burden of allergic rhinitis (AR) in community pharmacy: a global phenomenon. *Asthma Res Pract*. 2017;3:8.
67. Carr WW, Yawn BP. Management of allergic rhinitis in the era of effective over-the-counter treatments. *Postgrad Med*. 2017;129(6):572–80.
68. Members of the Workshop. ARIA in the pharmacy: management of allergic rhinitis symptoms in the pharmacy. *Allergic rhinitis and its impact on asthma*. *Allergy*. 2004;59(4):373–87.
69. Bousquet J, Cruz A, Robalo-Cordeiro C. Obstructive sleep apnoea syndrome is an under-recognized cause of uncontrolled asthma across the life cycle. *Rev Port Pneumol*. 2016;22(1):1–3.
70. Bousquet J, Agache I, Anto JM, Bergmann KC, Bachert C, Annesi-Maesano I, et al. Google Trends terms reporting rhinitis and related topics differ in European countries. *Allergy*. 2017;72(8):1261–6.
71. Bousquet J, O'Hehir RE, Anto JM, D'Amato G, Mösges R, Hellings PW, Van Eerd M, Sheikh A. Assessment of thunderstorm-induced asthma using Google Trends. *J Allergy Clin Immunol*. 2017;140(3):891–3.

Ready to submit your research? Choose BMC and benefit from:

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more biomedcentral.com/submissions

